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Challenges When Digital Services for Sustainable EverydayTravel is Innovated

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Abstract
This short paper introduce and investigates challenges when digital services for sustainable everyday travel is innovated. The notions of sustainable innovation, energy informatics persuasive technology and service ecosystem is used as a basis for a vision that facilitate the development and evaluation of persuasive solutions for sustainable travel. Based in this vision different challenges for innovation of digital services is discovered and research questions presented.

Keywords: Green IS, Sustainable Innovation, Solution Science, Driving Behavioral Change.

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INTRODUCTION

Personal travel is expected to increase, according to Traffic Authorities, from 2 200 000 to 3 000 000 journeys (36%) 2005-2025 in Western Sweden. Transport-related CO_2 emissions should decrease by 4% in 2010 and 75% in 2050, compared with 1990. In order to cope with CO_2 reductions it is estimated that the share for public transportation must increase from 24% to 40% by 2025 and that car riding to and from work must drop from 65% to 35%.

Enabling a shift from cars to public ways of transport means steps towards achieving eco-goals such as eco-effectiveness (Watson et. al. 2010), as commuters actively change their traveling behaviour and consume lesser amount of natural resources in order to accomplish the same traveling goals. It is also steps towards eco-equity as the use of commuter transport functions and services with better environmental performance (such as bicycle or public transport infrastructure, like bus, tram or train) means that each commuter consumes less resources which leaves more resources to be used by future generations, and if the systems are well-trimmed it may even be made to balance with the regeneration capability of energy resources.

We argue that it is the responsibility of the IS researcher to investigate and evaluate how IT/IS may improve environmental performance, and in particular investigate how sustainable IT/IS innovation may serve as a persuasive force to stimulate shifts towards more eco-friendly alternatives of transportation (i.e. doing the things that are right, and doing these things even better). For example, we consider it our responsibility to investigate how sustainable IT/IS innovation may increase the eco-efficiency of transportation assets when the volume of travellers of shared resources increases as a consequence of a shift from car commuting to commuter transport services with better environmental performance.

This short paper investigates the research question *what are the challenges to pursue when digital services for sustainable everyday travel is innovated based on exposed and accessible data?* This investigation is based on a vision for innovating digital services which is anchored in a tentative theoretical framework that presently encompass the notions of energy informatics, sustainable innovation, persuasive technology and service ecosystems.

THEORETICAL FRAMEWORK

Energy informatics

Energy informatics is a Green IS subfield that emphasizes the role that IS may have in reducing energy consumption and in particular CO_2 emissions (Watson et. al. 2010). The field cover the analysis, design and implementation of systems that increases the efficiency of energy demand and supply systems. It involve the compilation and examination of energy data to support optimization of energy distribution and consumption networks within or across different fields of application; e.g. the domain transportation of people.

Watson et. al. (2010) provides a framework - the energy informatics framework - which consists of a integrated set of elements that comprise a energy supply and demand system. The information system is in the core of this framework, which also includes eco-goals, stakeholders, procedures/norms/regulations/ economics, sensor objects, sensor network and flow network. Watson et. al. (2010) argues that the information system ties together the other elements within the two segments demand and supply. The framework could be used as a whole or could different elements be used in order to investigate problem areas within energy informatics.

Watson et. al. (2011) uses for instance eco-goals in order to discuss the results from an investigation into four green projects focusing transportation systems. They argue that addressing global warming requires strategic breakouts (a change to do the right thing; eco-effectiveness) rather than tactical improvements (doing things right; eco-efficiency). They mean that centuries of incremental additions of CO_2 cannot be turned around quickly with swift IT/IS development actions on a tactical level. Instead IT/IS innovation is needed which aims towards eco-effectiveness on a strategic level. They argue that it is the innovative systems that will be suggested now which will have a chance to redefine and influence how actors can behave in more environmentally ways tomorrow (Watson et. al. 2011). Pitt et. al. (2011) identifies ways in which smartphones can act as a vital and integral part of a green information systems and describes the potential how this new technology could contribute toward a more sustainable world.

Sustainable innovation

Sustainable innovation is according to van Osch & Avital (2010) an approach that aims to generate environmental, social and economic value for all stakeholders involved in IT/IS innovation endeavours which have the purpose to improve environmental sustainability. Sustainable innovation as notion should be viewed as an extension of the prevailing discourses on Green IT/IS (van Osch & Avital, 2010) and sustainable development (World Commission on Environment and Development, 1987). As an approach sustainable innovation goes beyond ecology as the only facet of sustainability and offers a three-fold approach that encompasses social, environmental and economic dimensions of sustainability in IT/IS innovation. One of the core aspects in the approach is that industries may be motivated to take responsibility for all stakeholders, future generations and the environment itself. Such responsibility needs to be facilitated by the injection of complementary means to environmental concerns, such as financial benefits and social benefits. Dao et. al. (2011) argues in line with this for the use of tools such an integrated matrix which combines the dimensions time (today/tomorrow) and perspective (internal/external) when developing sustainable innovations. The proposition stated is by developing sustainability capabilities to pursue the sustainability objectives and practices, industries will be able to achieve triple bottom line results, create sustainable value for both themselves and their stakeholders, and gain sustained competitive advantage (Dao et. al, 2011). This will support the industry to develop business cases that support IT-enabled sustainability initiatives, however it also implies multi-stakeholder innovation, which in turn must be managed and orchestrated in order to succeed (Hjalmarsson & Lind, 2011). The sustainable innovation approach provides a proactive and strategic approach to IT/IS innovation by focusing on creating positive and economically sustainable solutions to environmental and social challenges rather than on reducing and managing IT footprint (van Osch & Avital 2010).

Persuasive technology

Persuasive technology is coined as the term describing interactive technology aimed at changing people's attitudes or behaviours (c.f. e.g. Fogg, 1998; King & Tester, 1999). Further, Fogg (1998) claim that true persuasion requires intentionality. A technology only qualifies as persuasive when those who create, distribute, or adopt the technology with an attempt to affect human attitudes or behaviours . There are several domains for the application of persuasive technologies (such as e.g. marketing, health, and safety and security). One domain brought forward by King & Tester (1999) is the environmental conversation, by the use of web sites for

motivating eco-friendly behaviour (e.g. propagating information and motivating more ecologically minded attitudes and behaviours). The combination of (many) people being connected via Internet, and thereby enabled to communicate with a mass of people, and mobile technologies, the potential in affecting people's attitudes and behaviour for a sustainable society is promising.

Service ecosystem

Service ecosystems builds on an idea envisioned by Barros & Dumas (2006) that providers of basic or core web services via an ecosystem could augment their service by distribution and delivery functions made available to them by the ecosystem. For example could such a system provide means for payment or service exposure which could be used by the provider of a service to extend utilization of the service or add new functionality to the it (Riedl et. al. 2008). Via this ecosystem, service providers are brought closer to service consumers with the help of service brokers and service mediators. A service broker might facilitate the interplay between consumer and provider by integrating a service with other additional delivery functions such as payment, and a service mediator might offer translations between different service formats and other routine functions in order to support the broker to focus their core competences of refining new services. Through the flow in the service ecosystem - from service providers, mediators, and brokers - services are finally offered to consumers (Riedl et. al. 2008).

A VISION THAT FACILITATE INNOVATION OF PERSUASIVE SOLUTIONS FOR SUSTAINABLE EVERYDAY TRAVEL

In the vision presented in figure 1, a ecosystem is depicted in which travellers should be able to - guided by IT/IS solutions in general and smart mobile devices in particular - plan travels in a way suitable for them while at the same time being supported to select eco-friendly means of transportation[1]. The vision builds on the idea in energy informatics that IT/IS can play a role in reducing energy consumption, and thus CO_2 emissions (Watson et. al. 2010). Travellers should be able to base travel decisions on information about for instance the reliability of transport services and traffic, on the price, and on the environmental performance, provided to them via digital services that uses different data sources. Thus, travellers becomes consumers of digital information encompassing a potential to persuade them into utilize physical services in more sustainable ways (Fogg, 1998). The aim with the vision is to stimulate the accomplishment of eco-goals and also enabling social and economic value for different stakeholders in the system, as advocated by van Osch & Avital (2010). Viewing data and digital complementary assets as services, the flow from providers to travellers and from travellers back to the providers depicts a service ecosystem (Riedl et. al. 2006).

In this vision the traveller consumes data originally provided by the suppliers of data refined into novel services by brokers themselves supported by mediators. The broker could either be an actor within the personal transport industry developing digital services as a secondary service next to providing physical services and infrastructure in the flow network. However, these providers could also be external developers who either develops and supply digital services to consumers based on non-profit grounds (e.g. community developers (c.f. Lee et. al. 2003)), or based on selected business models (e.g. spanning from the IT-entrepreneur to

[1] E.g. view the demonstrator TravelGreener: http://www.youtube.com/watch?v=tnT-HxQ0nEA (Hjalmarsson et.al. 2010)

the global IT-company). Being brokers, all these stakeholders are besides suppliers of refined services also consumers in the ecosystem. They consume data and digital assets provided to them by public or private suppliers in order to refine them into novel digital services. The data supplied is foremost traffic, transport and environmental data, which are needed to develop and supply digital services suitable for travellers to plan and conduct everyday travel. However other types of data and digital assets from the public as well as the private realm is most certainly needed in order to boost innovation of new unique and personalized digital services for everyday travel.

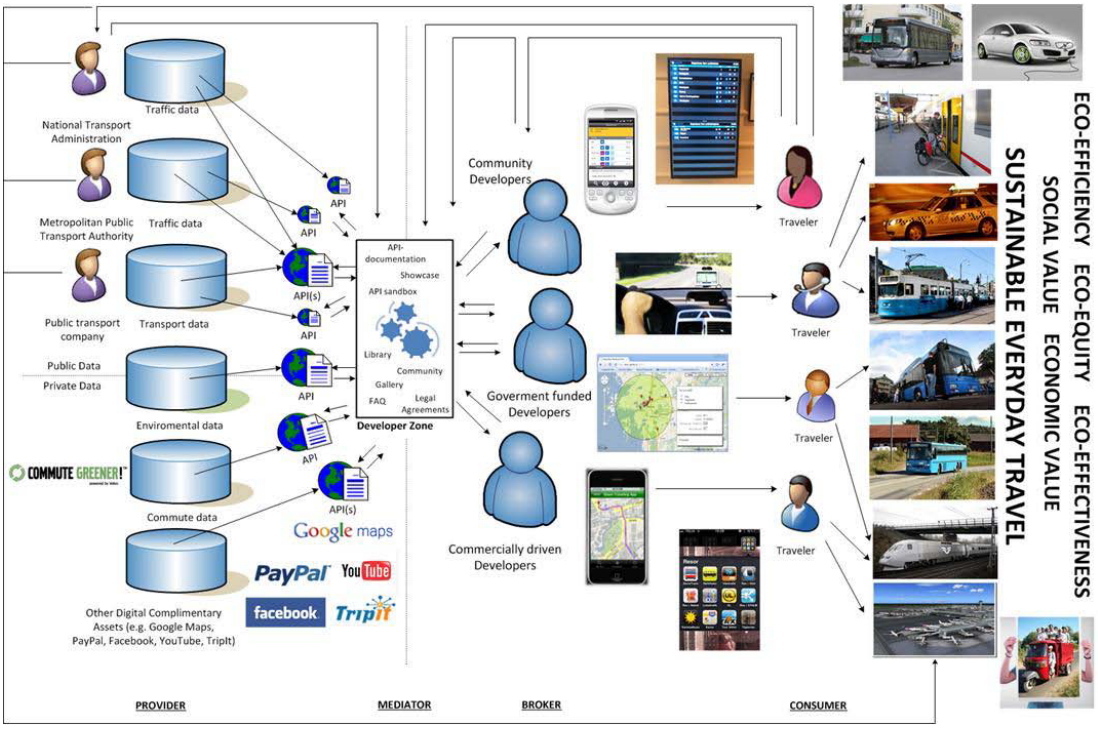

Figure 1. Enabling innovation of digital services for sustainable everyday travel

In order to facilitate this form of distributed development a developer portal is needed in the ecosystem acting as a mediator between the providers of data and the brokers of services. The aim with this "developer zone" is to facilitate the access to data via fitting and documented API:s (Application Programming Interfaces). It also facilitate and control distributed development by providing Showcases, API sandboxes, Libraries, Community services, Support Services, Gallery, User Behaviour, and Legal Agreement Polices in connection to the data sources which the portal connects to. The vision with the portal as a mediator is to stimulate people's activities of developing systems/services based on conditions created by others (suppliers, government, users etc).

The vision furthermore highlights the idea that consumers of digital services (i.e. the travellers) also are suppliers, not only consumers, in the ecosystem. For instance are they suppliers of feedback data that encompass opinions in regard to digital services, new ideas on digital services or the use of physical infrastructures and transport services. They are also providers of judgments of such services, and they provide directly or indirectly data about

traveling behaviour and mobility patterns etc. The brokers and the providers via the zone as mediator becomes thus consumers in the ecosystem. A network of sensors and different sensitized objects used by the travellers facilitates the feedback data provided to them. Consuming such feedback enables improvement of digital services, the design of new digital services and the discovery of ideas how and which data that should be provided in the ecosystem. This utilization could eventually also provide basis for ideas on new or changes in existing services as well as in the infrastructure which constitute the physical transportation system.

CHALLENGES WHEN INNOVATING DIGITAL SERVICES FOR SUSTAINABLE EVERYDAY TRAVEL

In order to better understand how digital services could be innovated various challenges must be met. Table 1 introduce a variety of challenges, which should be addressed in order to understand and organize a viable ecosystem for innovating digital services for sustainable everyday travel.

Challenge	**Motivation (instances of knowledge needs)**
Availability of data (API-design)	How can organizations hosting traffic data cater for developers' access to accurate data, which meets the needs of data in different usage situations?
Creating interest for exposed datasets	How can developers be attracted to use exposed data in the applications they construct?
Transferring organizational goals and visions among actors in the service ecosystem	How and to what extent can open access to data and distributed development be commenced, controlled and facilitated to adhere to organizational goals?
Understand the tasks and boundaries between different roles in the service ecosystem	Which tasks do different roles perform in the ecosystem and what characterize the boundaries between different roles in the system?
Orchestrating sustainable innovation towards eco-goals and sustainability	How and to what extent could sustainable innovation clusters working toward eco-goals and economic and social values be designed and orchestrated?

Understand consumers' needs in connection to digital services and sustainability	Which social values should be achieved during sustainable and distributed service innovation in order to persuade changes in travellers' behaviour - towards more sustainable travel? How to facilitate distributed service innovation that meets the social values that different categories of consumers have when public transport is or should be utilized?
Understand how economic value is generated in digital services which enables ecological sustainability	How is economic value generated at different points in the flow from provider to service consumer in the ecosystem? Which business models should be used in order to foster sustainable innovation in the service ecosystem? How and to what extent could new business be nurtured in a developer portal?
Good solutions innovated, but no utilization amongst users and no desired impact in the society	How could sustainable usage and desired impact be accomplished when digital services for everyday travel has been innovated? How and to what extent could the impact of the outcome from distributed development be evaluated?
The establishment of feedback channels in the ecosystem to ensure quality and value in the system	How should different types of feedback channels be established that improves the quality and the value delivered in the ecosystem?

Table 1. Challenges when innovating digital services for sustainable everyday travel

CONCLUSIONS

In this short paper various challenges has been introduced in relation to sustainable innovation of digital services for everyday travel based on accessible and exposed data. These challenges are anchored in a vision for a ecosystem that builds on the idea that a mediator (a "developer zone") stimulates people to develop systems/services based on conditions created by a set of other actors (providers, mediators, consumers etc). The paper argues that this is in line with the core perspectives in Green IS, that strategic initiatives is needed, mobilizing many diverse stakeholders in order to enable environmental friendly effects with the help of IT/IS. The paper also suggests that given the variety and pervasiveness of the end-user computing devices and end-user situations it is necessary for such a mediating platform to reach outside the scope of organizations traditionally catering for personal transportation. In order to achieve such effects the paper argue that sustainable IT/IS innovation must encompass and be orchestrated towards other dimensions of sustainability, such as economic and social value.

In addition the paper argue that sustainable IT/IS innovation must be include a facilitated flow of data from the provider to the consumer which is characterized by openness to relevant personal transportation data and connectivity between actors in this flow; for instance between developers (brokers) and travellers in order to understand needs, and between travellers and

operators (providers) in order to better understand the behaviours of different types of travellers. In addition a facilitated flow is also needed between developers (brokers), operators (providers) and the developer zone (mediator) in order to enable conditions for sustainable distributed innovation of digital services for the traveller.

The vision displayed in figure 1 as well as the challenges defined in table 1 creates a basis for further research with the overall objective to reveal how digital services for sustainable everyday travel could be innovated based on exposed and accessible data.

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