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CHALLENGES IN ESTABLISHING SUSTAINABLE INNOVATION

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Abstract

Within the field of information systems an interest in environmental issues has driven the agenda for research from green IT improvement to sustainable innovation. A challenge yet to investigate is how sustainable innovation involving a cluster of actors from multiple settings should be 1) designed and 2) orchestrated so that the innovation performed enables sustainable change. Processes for launching sustainable innovation should consequently be analysed in order to further investigate this notion. In northern Europe there is today a strong drive towards enabling initiatives utilizing mobile information technology improving the everyday transportation of people. This paper analysis the launch of a research and innovation cluster with the aim to develop information infrastructures and processes that stimulate distributed development of digital services for everyday travel. Events performed during the two-year start-up have been analysed identifying essential actions for network design and innovation orchestration, creating hypotheses, which enables further research about the establishment of sustainable innovation.

Keywords: Sustainable innovation, Network design, Innovation orchestration, Public transportation

1 Introduction

The earth consists of limited energy resources. In our society today, there exists material infrastructures and services designed and offered by man which requires the use of such limited resources. This could be to transport goods or to being transported as a person. Examples of material infrastructures in these situations are train/railway, trucks/roads, buses/roads etc, and examples of services are public transportation. These systems of transportation all consume energy and also creates an impact in the environment; i.e. emissions e.g. CO_2, NOx and Noise.

Pitt et al (2011), Watson et al (2010; 2011) and Melville (2010) argue that information systems have a role in reducing the consumption of energy and thus also emissions from such utilization. One of the core concepts in the model that Watson et al (2010) presents, the energy informatics framework, is the notion of eco-goals. Three broad eco-goals are prominent: eco-efficiency, eco-effectiveness and eco-equity (Dyllick and Hockerts 2002). Eco-efficiency is about using e.g. existing infrastructures in more eco-efficient ways than the current use signify. Eco-effectiveness strives beyond eco-efficiency stimulating a change of behavior in regard to energy consumption; e.g. performing transportation in other ways than today, in order to reach the same transport goal but with other means. The third goal, eco-equity, is about fairness in current consumption of energy in regard to future generations possibility to use the earth's scarce energy resources.

Reports have been made that there is a potential in increasing the co-utilization of the public transportation infrastructure provided in societies (UITP, 2010). There are also reports suggesting that one mechanism to increase co-utilization of public transportation is enhanced use of transportation and traffic information. Such information would enable travelers to better integrate public transportation in their everyday life (UITP, 2008). Due to that consumers have to utilize existing infrastructure and consume resources in more eco-efficient, eco-fair and eco-effective ways, there is a need for providing information systems for the co-ordination of such utilization. Importantly however, a solitary focus on environmental sustainability would not create desired effects. The scope of sustainability need to be expanded to include economic and social dimensions as well in order to create desired effects by people's changed behavior (e.g. Melville, 2010). An unresolved quest is still how information systems can be designed to increase the value (economic and social) of public transportation for consumers and at the same time stimulate travelers to make travel decision with the environmental impact as a factor for decisions ahead of, during and after transportation.

van Osch and Avital (2010) and Dao et al (2011) argues that the focus on environmental issues in information systems should go beyond both reducing and managing IT-footprint and the challenge how information systems could be used to measure CO_2 emission and energy consumption. Instead, to reach impact from innovation, they propose that a broader lens to be adapted that stimulates the creation of positive ecological solutions which improves the environment as well as provides social and economic value for users and stakeholders (c.f. also Elliot, 2011). van Osch and Avital (2010) label this intertwined approach to IS/IT development *sustainable innovation*. This pinpoints an interesting idea to the challenge of accomplishing eco-goals with new innovative green IS. Designing them in order to reach impact should not just be directed towards one of the three bottom line pillars of sustainability (Elkington, 1998), the environmental dimension of sustainability. Sustainable innovation should also encompass actions that ensure that green IS produces economic value (e.g. new business and/or improved productivity) and social value (e.g. amusement and/or safety), the other two bottom line pillars in sustainable development (Elkington, 1998).

Innovation in its core is about spanning and even breaking existing boarders. Using eco-goals as directions for the open-ended process of innovation means the involvement of a number of stakeholders. In their framework for energy informatics Watson et al (2010) divides stakeholders into three sub-groups: consumers, suppliers and government. On a general level, consumers as depicted above, represent the users of the material infrastructure that is provided to transport people in a collective matter; i.e. via means of public transportation. These consumers are however also the users

of information systems that improve the value of public transportation from environmental, social and economic perceptions. Suppliers in this sense are the suppliers of the material infrastructure used for public transport and the suppliers of the information systems that improve the use of these common means of transportation. The government is from one angle the body that provides regulation for how to operate and use public transport, and from another angle a major stakeholder in establishing a society which advocates that inhabitants and organizations acts in sustainable ways.

The fundamental hypothesis driving our research is that sustainable innovation in order to be successful requires the participation and collaborative power from numerous stakeholders of different types; spanning from consumers, suppliers to governments. We believe that this especially is the case when sustainable innovation is performed to create positive systems solutions within the area of public transportation. The process of establishing an innovation cluster (network) of participating stakeholders is thus the unit of analysis in this paper, and the research question addressed is *which essential actions are performed when sustainable innovation is established*? The analysis of such essential actions creates a basis to formulate specific hypothesis stating what might be required when sustainable innovation is established.

In the next section we elaborate on sustainable innovation and the domain public transportation. This is followed by an investigation into the theoretical notion of network design and innovation orchestration as a framework by which the activity of establishing an innovation cluster for sustainable innovation could be analyzed. A section describing the research approach applied for exploring the research question then follows this. The empirical case is presented and it is followed by a discussion which presents the results of the analysis; i.e. hypothesis of essential actions for an innovation orchestrator – the hub organization of an innovation network – when establishing a cluster of participating stakeholders in sustainable innovation. A section with conclusions and future research wraps up the paper.

2 Theoretical Framework

The research question in this paper addresses the establishment of sustainable innovation, with a special focus on the actions performed for network design and innovation orchestration during this first phase (c.f. figure 1). In this chapter the notion of sustainable innovation is explained in section 2.1 and in section 2.2 the domain of public transport. The theoretical framework used in order to understand network design and innovation orchestration is presented in section 2.3.

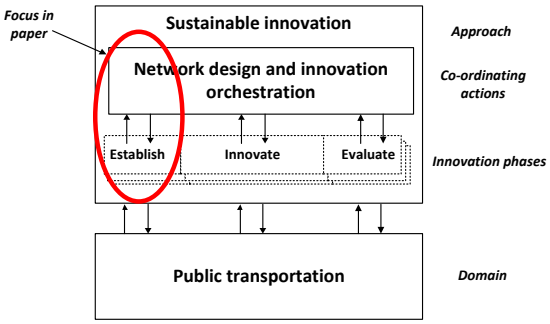

Figure 1: Establishing sustainable innovation in public transportation

2.1 From Green IT to Sustainable Innovation

In this section a shift is described from a focus on Green IT to sustainable innovation, which has a broader focus than merely making IT more eco-efficient and goes beyond reducing IT's energy consumption through green IT initiatives. Murugesan (2008) states that green IT refers to

environmentally sound information technology. The notion involves the investigation and practice of designing, manufacturing, using, and disposing computers, servers, and associated subsystems (printers, monitors, hard drives, networking, and communications systems) efficiently and effectively with minimal or no impact on the environment. Green IT also strives to achieve economic viability and improved system performance and use.

Watson et al (2008) who recognise green IT, do also expand the focus by adding the notion of green IS, which has a greater connotation because it tackles a larger challenge than green IT. Green IS refers to the design and implementation of IS which contribute to that processes become environmentally friendly. Frameworks to assist in the development of green IS becomes therefore vital (Watson et al, 2008:3). One example is the energy informatics framework (Watson et al, 2010), which presents a supply and demand system with both social and technical components. It consists of a set of core categories: eco-goals, stakeholders, policies and regulations, corporate norms, information systems, sensor networks, flow networks and sensitized objects, and relationships between them. The framework is designed to aid in the development of environmentally sound socio-technical systems.

van Osch and Avital (2010) investigates the expansion from green IT to green IS/IT with the notion of sustainability as criteria. They argue that green IT consider information technologies as a part of the environmental problem and addresses the question of how to reduce the environmental footprint from technology by cutting carbon emissions, energy consumption, and waste throughout the lifecycle of information technologies. Green IS, they state, considers information technologies and information systems as parts in the solution of the environmental problem and this field analyses systems potential role in supporting organizations to manage their environmental footprint. However, the ecological dimension is just one of three pillars of sustainability (Elkington, 1998). Sustainability also includes the pillars of social and economic sustainability not enough addressed in green IS/IT (van Osch and Avital, 2010).

Sustainability stands for the capacity to endure (e.g. to remain, continue, sustain). In order to maintain, change or innovate new sustainable social and technical systems the economic value must be addressed. van Osch and Avital (2010) claim that sustainable innovation is about an industry's fundamental motivation to take responsibility for all stakeholders, future generations and the environment itself. Industries, privately or governmentally owned businesses, are in the forefront in generating new innovations (Dao et al, 2011). In order to turn our societies into more environmental sound, every idea of new green IS/IT should be turned into a business idea in order to trigger technical and social innovation. In addition, sustainable innovation also highlights the importance of multi-stakeholder innovation (van Osch and Avital, 2010:3): "*i.e. of collective engagements among businesses, governments, educational institutions, and the community — for generating sustainability.*" This is in line with Watson et al (2010) who points out that innovating new green IS/IT needs involvement of several different stakeholders. During sustainable innovation these different stakeholders needs to become engaged in the proactive process of generating sustainable value. This creates the basis for a well-designed partnership, which Elkington (1998) argues is needed in order to succeed with a sustainable enterprise.

2.2 The public transportation domain

Innovation is always related to something, e.g. products, processes, technical and/or social systems. In regard to transportation of people, innovation could be done in relation to all or a particular of these aspects. This steams from a need to establish an efficient transportation system of people, locally and globally. The daily situation in local and global environments is characterized by different sustainable problems like traffic congestion, air pollution, limited accessibility as with more general policy and quality issues related to residents' everyday life situations. This has spearheaded efforts to change the modal split of transport from individuals in cars to collective and/or environmental friendly means of transport and in Watson et al (2011) four such initiatives are evaluated based on information drives analysis.

Franzén (1999ab) states the attractiveness and quality of the travel and transport services made available by public transport authorities and organizations must be increased in order to succeed with innovations in the transportation domain. Watson et al (2011) has a similar line of argument as they conclude that a public transport initiative (a new bus system) in Santiago failed partly because it was launched before the complementing information system was operational. Franzén (1999ab) points out that dynamic digital services should be at the heart of stimulating innovation in this domain and address a need for a holistic view on public transportation in order to achieve these services. In Franzén (1999ab) a framework is presented for understanding the public transportation process from this holistic viewpoint. The framework could be used to design digital services for public transportation. The domain consists of a complex set of supply and demand systems, including e.g. subsystems, actor dynamic relationships, and conditions/disturbances from other social and technical systems. In relation to van Osch and Avitals' (2010) call for multi-stakeholder innovation during sustainable innovation, Franzén (1999b) gives important insights to the public transportation process in regard to which stakeholders that should constitute a cluster of innovators in a sustainable innovation endeavor. Different types of stakeholders are defined in the framework such as operators, traffic control operators, passengers/travelers, administrators, politicians, and service providers.

2.3 Design and orchestration of innovation networks

An innovation cluster resembles the notion of an innovation network, which could be viewed as a loosely coupled system of autonomous organizations (Dhanaraj and Parkhe, 2006). The loosely coupled stakeholders in an innovation network have been described as a system having its subsystems being both decoupled and tightly coupled (Orton and Weick, 1991). In innovation networks different organizations could be conceived as taking different roles. Three types of network roles – hub, semi-peripheral, and peripheral – are identified by Gulati and Gargiulo (1999). As pointed out by Watson et al (2010), van Osch and Avital (2010), and Franzén (1999b) social systems, in society, besides organizations also consists of consumers and governmental agencies which widen the innovation network to a cluster of members organisations, agencies and the public.

Dhanaraj and Parkhe (2006) identify the hub firm as the orchestrator of innovation networks. This entity possesses prominence and power gained through individual attributes and a central position in the network/cluster structure using its prominence and power to perform leadership when pulling together the dispersed resources and capabilities from different members in the network/cluster. It is assumed that each actor in the network/cluster actively will pursue their own self-interest and that the hub firm influence networks mainly through network design and innovation orchestration activities (c.f. figure 2).

Innovation orchestration includes a set of deliberate, purposeful actions undertaken by the hub firm as it seeks to create value (expand the pie) and extract value (gain a larger slice of the pie) from the network. Network design consists of recruitment processes, which enables the hub firm to adjust the size in the network, the position in the network and its structure. Dhanaraj and Parkhe (2006) explain three processes for designing the innovation network/cluster. They argue that the focus for the hub firm is then recruitment. By a strategic choice of partners the hub firm can influence the cluster by significantly changing network membership (size and diversity) and structure (density and autonomy). With the help of these activities the hub firm can control its position in the network, keeping its centrality and status.

Dhanaraj and Parkhe (2006) identifies three fundamental orchestration activities which a hub firm must perform to manage network innovation output; knowledge mobility, innovation appropriability, and network stability. Knowledge - the chief currency in innovation work - is the value exchanged in the network/cluster. Research organizations would thus potentially be an essential actor in such a setting. Knowledge mobility is defined as the ease of how knowledge is shared, acquired, and deployed within the network. Three sub-processes to enable knowledge mobility are presented:

knowledge absorption, network identification and inter-organizational socialization (Dhanaraj and Parkhe, 2006).

The second task of orchestration is managing innovation appropriability that governs an innovator's ability to capture the profits generated by an innovation. Three sub-processes, which the hub firm should focus on in relation to this task, are: trust, procedural justice and joint asset ownership (Dhanaraj and Parkhe, 2006:663). The third form of orchestration is activities fostering network stability, which is referred to as dynamic stability. Dynamic stability aims for a nonnegative growth rate allowing for entry and exit of network members. As orchestrator, a hub firm can increase the networks dynamic stability by enhancing reputation, lengthening the shadow of the future, and by building multiplexity (Dhanaraj and Parkhe, 2006:664).

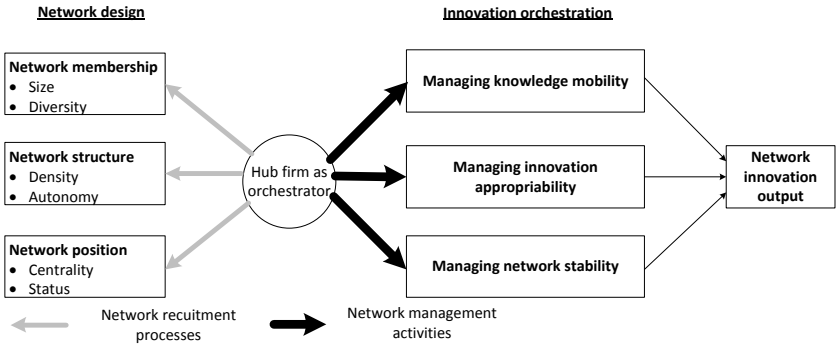

Figure 2: Innovation network design and orchestration (based on Dhanaraj and Parkhe, 2006)

We argue based on our theoretical review that innovation network design and orchestration is not adequate addressed in regard to sustainable innovation. The research question in this paper address which essential actions that should be performed in order to establish sustainable innovation. As perspective to govern the analysis the framework provided by Dhanaraj and Parkhe (2006) is used to guide the analysis. The result of the analysis creates both the prerequisites to 1) develop hypotheses for essential actions when sustainable innovation is established to be validated later, and 2) refine the used framework.

3 Research Design and Case Description

3.1 Research design

Empirically this paper is based on a two-year (2008-2010) period of recruiting members, establishing finance, and performing diagnosing and designing actions within the program Innovation for sustainable everyday travel (ISET). In 2010 the program has managed to recruit 16 members spread as 4 research organisations, 3 information providers, 4 service developers/providers and 5 sponsors. The total turnover is 2010 more than 3 MEuro and being a regional initiative it is now gaining strong resonance on national and European level. The research approach adopted in the paper is an empirically driven theory development building on established theory related to public transport, sustainable innovation and network innovation for the purpose of investigating the nature and effects of sustainable innovation. By this report on experiences from a local practice situation we hope to enable other initiatives that would be transferable to general practice and the scientific body of knowledge. Empirically, we base ourselves on the analysis done of action design research actions (Sein et al, 2011) performed by the team acting on behalf of the hub organization. Secondly, we base ourselves on 25 interviews and video recorded workshops performed by the same team with involved members of the network for the purpose of conducting a diagnosis in a canonical action research spirit (Susman, 1983). Essential actions performed by the network hub have from these data been reconstructed. The actions have been brought forward for the purpose of developing hypotheses to

further investigate how sustainable innovation is established and how network design and innovation orchestration could be understood. Our conception of an hypothesis, in this setting, is founded in the idea of generalizing essential actions, based on empirical experiences from the establishment of the research program, that seem to be of importance for network design and innovation orchestration informed by the framework put forward by Dhanaraj and Parkhe (2006). The identified hypotheses are to be seen as challenges in establishing sustainable innovation, to govern and be tested in further research.

In our analysis we rely on the same division of actions as proposed by Dhanaraj and Parkhe (2006), i.e. making a distinction between orchestrating actions for network management activities and network design actions for network recruitment processes. This is done to both address the challenges in establishing of an innovation network initiative and as a foundation for adaptation of the framework to address sustainable innovation.

3.2 Case description

The Viktoria Institute (www.viktoria.se) was founded in 1997 at the initiative of the local industry in the West Region of Sweden. The mission of the institute is to perform research and innovation on applied information technology to support Swedish automotive and transport industry to achieve sustainable development and growth. Working towards these goals makes Viktoria an appropriate hub firm in innovation projects where the objective is to innovate information systems that support either sustainable vehicles or processes. In the beginning of 2008 members of the Viktoria Institute teamed up with members from governmental agencies and transport authorities in the West of Sweden with the common task to decrease car commuting in the context of city and regional growth. Main stakeholders were members from the so-called DART-group; a joint collaboration set up by public transport authorities in the Western Region of Sweden. A pre-study was performed in late 2008 and early 2009 analysing how a joint digital infrastructure (a gateway) could be defined in order to open up information resources that the public authorities possess with travel and transport data (real-time and static data). The conclusion was that the overall aim with this "gateway" should be to stimulate parties outside the public authorities to, in a distributed way, develop new digital services that facilitate travellers to access, and use, means of public transport. During 2009 the pre-study was reorganized as an innovation program, labelled Innovation for sustainable everyday travel (ISET).

ISET was divided into six interconnected work packages. In order to stimulate that the work covered all three pillars of sustainability three of the packages each addressed ecological sustainability (WP: Environmental sustainability), economic sustainability (WP: Business design) and social sustainability (WP: Travellers current and future needs). These interconnected work packages creates condition for the engine in the innovation work. The engine consists of two interconnected work packages focusing the stimulation of infrastructure innovation (WP: Digital infrastructure) and service innovation (WP: Digital services). The sixth work packages (WP: Project design and orchestration) stages, coordinates and evaluate the work in the different work packages. The work performed in this latter work package forms the basis for the analysis made in this paper.

4 Analysis

Due to space limitations we do not have the possibility to present a longer story of the case in this paper. In our analysis of the consecutive course of events, different orchestration actions as well as network design actions have been identified. These are captured within eight (no. 0-7) key innovation events and two (no. 1-2) key research events during the establishment of the program Innovation for sustainable everyday travel (ISET) (c.f. table 1 and figure 3 below). The main motive for this sustainable innovation endeavour was a frustration about lead times and coverage of services previously constructed by involved authorities, and the pressure from the Swedish society to strategically expand the market share of public transportation with 50% until 2025, in order cope with

different sustainable problems like traffic congestion, air pollution, and limited accessibility. In the beginning of 2009 Viktoria Institute was trusted by the stakeholders as the hub firm to lead the transformation of the results from the pre-study into ISET for innovating Green IS solutions that should meet these challenges (key innovation event 0). The pre-study gained valuable insights as the basis for further recruitment of network members (of heterogeneous (private/public/research) organizations) and initiated a successful fund raising effort during 2009 and 2010.

Network design actions	***Orchestration actions***
Key Innovation Event 1: Towards the first approved funding - Sjuhärads kommunalförbund (spring-09)	
• Differentiation of the stakeholders in an inner and an outer circle • Initiation of the process of raising network funding from multiple sources • Jointly design of appealing applications directed to Sjuhärads kommunalförbund (7H) and Vinnova • Definition of six work packages; Administration (WP1), Infrastructure Innovation (WP2), Service Innovation (WP3), Today's and Future procedures of Everyday Travel (WP4), Value Chains and Business Models (WP5), and Sustainability (WP6). • Approved funding from 7H (112 K€ cash and 112 K€ in-kind) and Swedish ICT (56 K€) for the period 2009 – 2011 (and that 7H joined as a member of the network)	• Stability management during establishment of an in-novation cluster/system when enhancing the reputation of the hub firm and via building multiplexity • The use of affiliations to other research institutes by the core team at (Institute name to be included). • Increased possibility of multiplexity
Key Innovation Event 2: Towards a common design vision in the innovation network (fall-09)	
• Improvement of the networks density by co-finance from University of Borås (862 K€) and other partners (895 K€) for in-novation activities during 2009-2013. • Application sent to InMotion/VGR and Vinnova	• The emergence of a common design vision based on a diagnosis according to CAR faced by the DART-group • Knowledge mobility managed by knowledge absorption, network identification and inter-organizational socialization • The emergence of a rich picture depicting the problem situation viewed by (Institutes name to be included) ability to identify, assimilate, and exploit knowledge from the environment. • Absorbing relevant knowledge from the members and transfer this back to the network • The use of the business language used by the DART-group • Improved socialization through workshops and interviews • Improved stability by improved confidence
Key Innovation Event 3 and 4:Toward additional funding - InMotion and Vinnova (fall-09)	
• Recruitment of InMotion/VGR as a sponsor for the purpose of generating resources for service innovation (441 K€ for 2010 – 2012) • Recruitment of Vinnova (after a declined application) as a sponsor for research purposes (615 K€ for 2010 – 2013) • Strengthened position of Viktoria as the hub	• Stimulation of interaction and knowledge transfer by the use of modeling techniques, business (local) language, and workshops. • Further network design and orchestration by the use of the joint (established) design vision and approved applications • Expanded multiplexity by including a pre-study focusing mobile services for ridesharing in the initiative • Expansion of the network's capability in regard to sustainable development/innovation
Key Innovation Event 5: Program kickoff (spring-10)	
• Strengthening of the information broker's role (earlier being recognized as a service provider) • Identification of actors, roles, and procedures for a developer zone • Expansion of the outer circle by the association of actors of national interest and interested parties from other regions	• Management of business opportunities recognized by the information broker by the distributed equitably and knowledge sharing/transfer • Management of agreements by (Institutes name to be included) as the hub organization by (re-)building trust and innovation appropriability • Pre-meeting with the DART-group in order to secure a content-driven dialogue and also to secure that the language (socialization) reflected practices
Key Research Event 1: Establishment of research agenda (spring-10)	
• Identification of four research topics (based on applications and empirical data); distributed development, environmental sustainability, adaptive systems and innovation orchestration.	
Key Innovation Event 6 and 7: The DevZone workshop and the ServiceProvider workshop (spring-10)	
• Temporary expansion of the network in size and diversity to provide useful experiences and motives for using a	• Changed prioritization between the different work packages • Pre-meeting with network members prior the DevZone workshop • Facilitation of the knowledge mobility during the DevZone workshop

DevZone • Knowledge transfer between different initiatives by co-utilization of funds • Further expansion of the outer circle • Establishment of a web site for ISET to further strengthen the network position, and to improve the reputation and knowledge mobility within the network	to reach consensus about the vision of a develop zone (as technical infrastructure and as business case) • Information given to service providers of what goes on • Discussions and agreements of how to include new business partners (led by (Institutes name to be included) as the hub firm) • Initiation of the agreement related to intellectual property rights • (Re-)anchoring of that (Institutes name to be included) acts as fund manager
Key Research Event 2: Research reflections and conceptualizations of first findings (spring-10)	
Data analysis and reflections as well as production of the first research publications	

Table 1. Key events in the establishment of ISET related to network design orchestration performed by Viktoria Institute as hub firm

The effort described in table 1 established ISET as an innovation and research program with a viable cluster of multiple stakeholders, funds, an appropriate structure, and a hub firm with a strong network position. The program has both expanded and transformed resulting in ongoing research as well as innovation; with tangible results for the practices involved in the network and the area of public transport in Western Sweden as a whole. As figure 3 demonstrates, the effort up til 2010 should be considered as the end of the establishment of the program. This augmented development is an effect of the launch of the program on, first, local, and then on, regional level. The innovation as well as the research efforts will as a consequence transform from perceived as possible to innovation in progress and research published, shedding light on some of the research topics advocated in the fields of e.g. sustainable innovation and Green IT/IS.

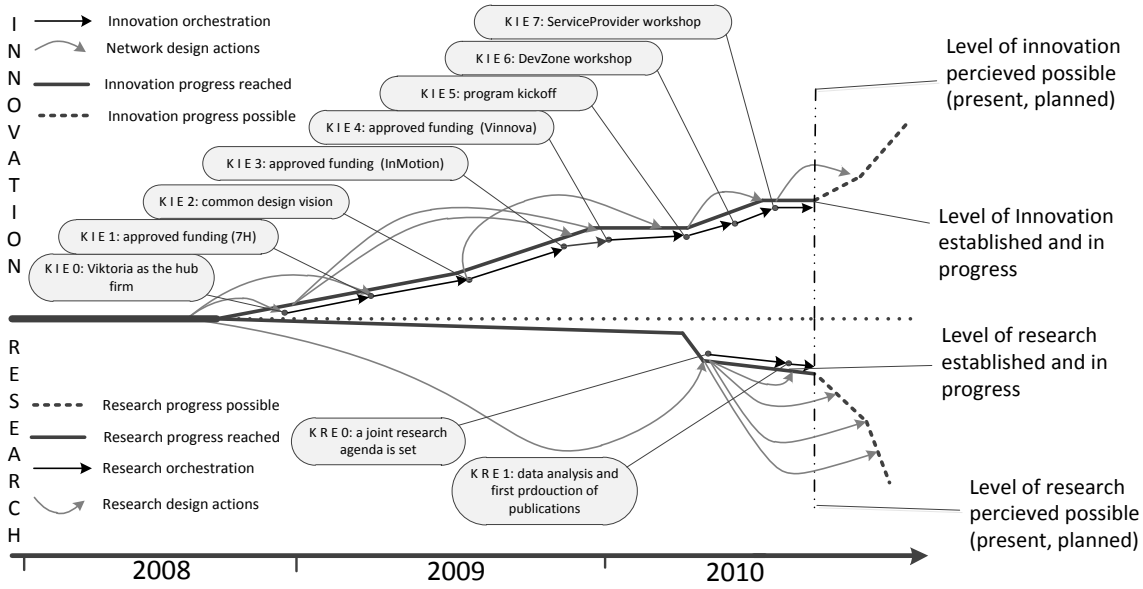

Figure 3: An account of the launch of ISET

5 Discussion

As pointed out in previously, researching the development of green IT/IS necessarily need to cope with the environmental challenges that consumption of the earth's assets mean. Research topics and eco-goals provided by e.g. Watson et al (2008; 2010; 2011) and guidance of research methodology to use gives good and important, but not complete directions, in how research that matters in the field of sustainable innovation could be established. The position taken in this paper is that the success of green IT/IS innovation needs to incorporate several dimensions of sustainability going beyond

environmental concerns. Such expansion is addressed within sustainable innovation (van Osch and Avital, 2010). The current theories on sustainable innovation do however not cover actions of network design and orchestration. By building on the framework in Dhanaraj and Parkhe (2006) as guidance for our conceptualization (and thereby our theoretical foundation) in combination with the key events (and thereby our empirical foundation) depicted in table 1, hypotheses for guiding actions in network design and orchestration have been identified (c.f. table 2).

Guiding actions	**Network design implications**	**Orchestration process implications**
Accessibility to data and services is ensured	To heighten network status	To improve knowledge mobility
Multiple financial sources are continuously approached based on emerging findings	To secure and escalate network funds	To create affordances for managing network funds
Production and visualization of (prototypical) artefacts is prioritized early	To inspire network members to become engaged and take position	To create affordances for managing network funds and innovation appropriability
Different dimensions of sustain-ability (environmental, financial, and social) are addressed in the project design and orchestration	To guide the network design	To ensure focus in the orchestration process
A continuous knowledge flow between demand and supply systems is addressed in the project design and orchestration	To enable the identification of relevant actors to be recruited to the network	To ensure focus in the management of knowledge mobility
Engagement in the network is secured successively by making roles, positions and stakes of the actor's explicit	To manage network position, structure, and membership	To create foundations for the hub firm to orchestrate based on different actor's desires and possibilities
Preliminary research topics related to researching actors are defined	To raise the probability of receiving (some) network funds and enable the identification of the stake of researching actors	To establish prioritization for the use of different networks funds as well as identifying content in the management of knowledge mobility
An approach for applied research addressing the needs of the network is established and anchored	To establish foundations for recruiting researching actors (knowledge developers)	To ensure scientific well founded knowledge base in the management of knowledge mobility
A joint design vision to be continuously refined and evaluated is establishment early	To inspire network members to become engaged and take position	To create foundations for identifying knowledge needs, managing network stability and requirements for network design
Incremental feedback informed by the evaluation of the network innovation output is enabled	To become informed on evolving requirements on the network design	To become informed on evolving requirements on the orchestration process

Table 2: Guiding actions as hypotheses for establishing sustainable innovation

The discovery of the guiding actions informs about new processes that are not discussed in the framework by Dhanaraj and Parkhe (2006). As e.g., the recruitment of network funds is based on the case of most importance when sustainable innovation should be performed. Sources for the network funds could either be internal and thus by the actors participating in the network or external and then by sponsors continuously becoming parts of the network.

Funds can be provided as cash or in-kind (efforts performed by members of the network acting on behalf of the network). In addition, these funds must be managed which is the basis for the orchestration process managing network funds which not either is discussed by Dhanaraj and Parkhe (2006). Based on the analysis of the case figure 4 presents a refined framework for design and orchestration necessary for sustainable innovation.

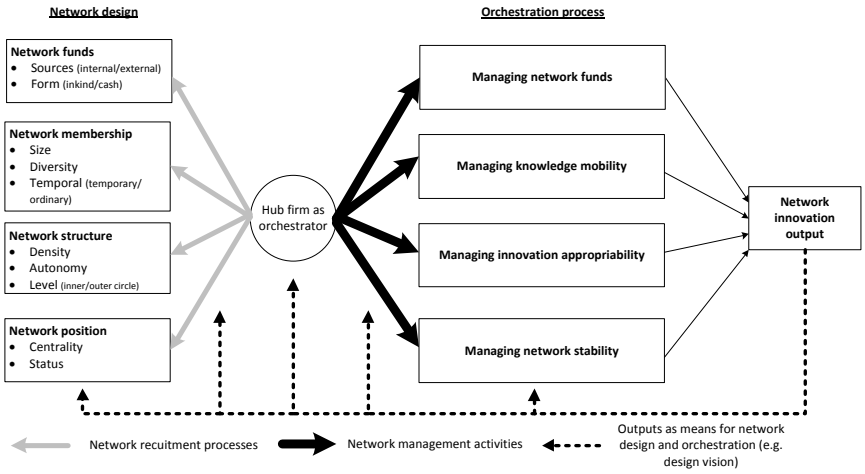

Figure 4: A refined framework for network design and innovation orchestration

6 Conclusions and future research

Based on the establishment of ISET we conclude that research topics and research methodologies which Watson et al (2008; 2010) and Melville et al (2010) advocate are essential components when green IS/IT innovation is performed. These components create basic guidance when a common design vision is formulated for initiatives of sustainable innovation, when applications for funding are designed, and when research topics are framed and specified. However a wider lens during the innovation is also needed taking in consideration the economic and social value which the green IS/IT innovation should provide (c.f. van Osch and Avital 2010; Dao et al 2011).

In addition, guidance for establishing the program as an innovation network is needed transforming the perceived ideas of innovation and research into reality and thus research and innovation in progress. Our case shows that this is of particular importance when such initiatives are realized in the context of public transportation as it contains many stakeholders with different perspectives and agendas on different levels in society. Being successful in creating substantial effects of sustainable green IS/IT solutions require the establishment of a viable innovation network with a variety of stakeholders from different organizations with different interest and stakes. Our point of departure is that it is necessary to engage many actors, on different levels, to make sure that (positive) environmental effects are created enabled by addressing other dimensions of sustainability.

The case provides data that concludes that the hub firm, responsible for the design and preservation of the network, was guided by the processes that is included in the framework for innovation orchestration that Dhanaraj and Parkhe (2006) presents. The data however also shows guiding actions in detail performed by the hub firm when network design and innovation orchestration has been conducted. These actions have been formulated as hypotheses to be verified / falsified based on the progress of the used sustainable innovation initiative and also based on data from other cases. It also gives the base to propose a refined framework for network and orchestration, which in addition includes processes for raising network funds and managing funds. It also highlights that outputs could be used as means for network design and orchestration which is not stressed in the original model. These means should be regarded as essential components in an iterative approach for network innovation.

As future research we have identified a need to further elaborate and conceptualize the actions and processes identified in theory and practice. A second line of further research is also to enhance the model and include constituents of research design and research management to complement the focus on the role of knowledge in sustainable innovation. A third line of research is to follow the

development of ISET and longitudinally investigate how network design and orchestration is performed during the whole lifecycle for a sustainable innovation program and thereby also study the effects of the networks design and orchestration performed during the establishment of the initiative.

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