XXV. International RESER Conference: Governance for collaborative development of service and system innovations

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This paper studies the multi-actor collaboration in the service innovation using the concept of ServPPINs. We concretize forms of such new governance mechanisms in which the solutions to societal problems are based on the integration of technological and service based novelties, and which appreciate partnerships, negotiation and trust between multiple kinds of actors. The study focuses on service innovation in the environmental sector.

1. Introduction

The objective in this paper is firstly to study the collaborative forms of system and service innovations and secondly to illustrate how the collaboration in innovation can be supported with the mechanisms of network governance (e.g. Lévesque, 2013; Hartley, 2005; Moore & Hartley, 2008). The focus is specifically on *service and system innovations in the environmental sector*.

Environmental sustainability is one of the so called “grand societal challenges” referring to extremely complex global societal problems that are systemic by nature and cannot be solved via individual product or service innovations created in individual organisations. Conversely, the challenges require the combination of various innovations and their effective dissemination on the basis of continuous interaction and dynamic between different organisations and parts of society (Toivonen, 2015; Geels, 2002; Rubalcaba et al., 2013; Gadrey, 2010; 2004; 2010). Thus, besides the combination of technological and service innovations, system and social innovations are required. *System innovation* refers to a renewal of whole set of networked supply chains, patterns of use and consumption, infrastructure, regulations etc. that constitute the socio-technical system providing basic services such as energy provision (Smith et al., 2010). To develop system innovations new operational model based on the simultaneous development of organisations, technologies, services and multiple network relationships (Gallouj, 1994; 2002; Windrum and García Goñi, 2008; Harrison et al., 2010; Rubalcaba et al., 2012) are required.

A prerequisite for the realisation of these system level challenges is the active engagement of various actors in the creation, implementation and diffusion of innovations. Thus, system innovations are interlinked with *social innovations,* characterised in the recent literature by the two different aspects of social: it is social by its ends and by its means. First ‘social’ refers to the societal challenges (e.g. environmental sustainability) innovations are aiming to solve and the second aspect of ‘social’ refers to participatory and networked processes without which it is not possible to create innovation in a multi-actor environment (Toivonen, 2015; Harrisson 2011).

However, in the literature the networked structure of innovation has been understood only partially. Large amount of literature is focused to analyse innovations from the organisational perspective (Moore & Hartley, 2008) and typically private and public innovations have been studied in isolation (Rubalcaba et al., 2013). In addition, understanding the different logics and drivers of innovations in private and public sectors is insufficient. That may produce a partial and incomplete understanding of the drivers, dynamics and impacts of innovations and services (Levesque, 2013; Moore & Hartley, 2008; Hartley, 2005; Rubalcaba et al., 2013). What is needed in the comprehensive understanding of the collaborative development processes providing societally important innovations and how it can be supported from the perspective of broader social decision-making system (Moore & Hartley, 2008.)

Recently introduced network concept ServPPIN (Public-private innovation networks in services; Gallouj et al., 2013) aims to bridge this cap and focuses to the complementarities and synergies between public and private service providers (Rubalcaba et al., 2013). ServPPINs have been developed as a mode for organising diverse actors, competences and knowledge in complex service innovation processes and thus for driving the systemic change in flexible, cooperative and interconnected way (di Meglio, 2013). They can be seen as a practical way to create cooperative and interactive arenas to tackle the growing complexity. These new mixed organisational arrangements have mainly emerged as a result of the modernisation and reform trends in the public sector reflecting a change in focus in public service provision: from cost-efficiency, markets and consumers towards complexity, co-production and public value (Rubalcaba et al., 2013; Levesqué 2013). This development manifests the broader paradigmatic change gaining ground in the governance system. Instead of hierarchical top-down coordination (e.g. new public management), there is a tendency towards non-hierarchical, de-centred governance mechanisms (Lévesque, 2013; Hartley, 2005; Sorensen & Torfing, 2007). The new networked way of governance is seen as a possible answer to the challenges posed by increasing societal fragmentation, complexity and dynamism (Sorensen & Torfing, 2007).

This paper studies the multi-actor collaboration in the environmental services using the concept of ServPPINs (Gallouj et al., 2013). We concretize forms of such new governance mechanisms in which the solutions to societal problems are based on the integration of technological and service based novelties, and which appreciate partnerships, negotiation and trust between multiple kinds of actors (Hartley, 2005; Voss et al., 2007; Moore & Hartley, 2008; Levesqué, 2013.)

Empirical data of the study is collected in Finland and describes on a new policy instrument SHOK (Strategic Centers for Science, Technology and Innovation) accelerating service, system and social innovations in the area of environmental sustainability. Data has been gathered from face-to-face interviews (35 in total), observations of six collaborative workshops, program documents and other strategy material.

The paper is structured in five sections. The second section after this introduction presents the central literature focusing on system and service innovation, new governance mechanisms to support the innovation development in the complex and system context and ServPPIN as a manifestation of novel networked based governance. The third section presents the case context in energy and environment sector and research methodology we have applied in data gathering and analysis. In the fifth section we describe our results and the final section sums up the study, provides some managerial and policy implications and gives ideas for further studies.

2. Theoretical background

2.1. System change through social innovation

Today the challenge of sustainable development is increasingly understood as a transition towards more sustainable socio-technical systems (Elzen et al., 2004; Geels, 2010). The perspective of socio-technical systems acknowledges difficulty in studying the sustainability of isolated technologies and services, if not analysed as embedded in a broader context. It points out strong interdependencies between various elements of the systems which impede new ways of organising the provision of renewable energy, for instance. The analytical challenge is to understand these interdependencies in a dynamic system, and then to identify how innovation can induce a transition to other, potentially more sustainable, systems. (Geels, 2005; Smith et al., 2010.) Sustainable systems innovation implies that major changes are required along the entire production-consumption chain, its flows, its multi-level architecture, its institutions and structures including policy and governance processes, and – not least – the behaviour of the actors involved in it, from resource extraction to the final consumption of goods and services (Weber and Hemmelskamp, 2005; Smith et al., 2010).

However, the current literature on systemic change concentrates relatively much to the introduction of new technologies and obscures the discussion and questions how to intervene in ordinary practices and dynamics to accelerate the systemic change (Showe and Walker, 2010). The perspective of social innovation is needed to create understanding of the participatory and networked processes without which it is not possible to create innovation in a multi-actor environment (Toivonen, 2015; Harrisson, 2011).

This paper studies the social innovation as participatory and collaborative processes which are necessary for the emergence and implementation of innovations in a multi-actor environment. Also in the novelties created, new ways of interacting is an important ingredient. Thus, the activities and actors involved have often been highlighted as the most distinctive feature of social innovations. Social innovations may emerge at the grassroots level among users and employees; they may be produced in the collaboration of private, public and third sector organisations; or they may be initiated by policy makers and regulatory bodies. In all cases, integration of bottom-up and top-down processes is essential (Rubalcaba et al., 2013).

Bottom-up grassroots activities are seen as an ‘engine of social innovations’. The process of creation and implementation of social innovations highlights empowerment: the role of citizens is an active co-developer. The importance of bottom-up processes is clearly observable in the sustainability context. The behaviour of consumers has a crucial impact on the achievement of the goals set. A change in user preferences is necessary in order to avoid undermining the improvements in the production and delivery of energy by consumption patterns (Weber and Hemmelskamp, 2005).

Equally important are the top-down processes which translate the general objectives into concrete policies and practices in circumstances characterised by societal and political dispute (Meadowcroft, 2009). They are needed for the materialisation and dissemination of social innovations. Community decision makers and company ma-

nagers have to support, recognise and organise bottom-up processes in order to make ideas implementable and scalable (Høyrup, 2010). Policy actors have to enhance society's innovation capacity by revitalising innovation institutions and by fostering the innovation activities of public, private and third sector organisations (Rubalcaba et al., 2013).

2.2. Governance mechanisms to accelerate systemic change

Above described developments have significant implications to public policies and create need for new governance approaches that support the collaborative and dynamic development and implementation of social and system innovations. In addition, the future of services are seen to shaped through new type of governance mechanisms which includes the rise of networks and partnerships, innovations as democratic practice, the development of "choise" and co-production of service models (Langergaard, 2011; Newman & Clarke, 2009).

Even the tendency in the literature is towards networked forms of governance (Levesqué, 2013; Moore & Hartley 2008) there is no agreement that in practically network governance is currently the dominant steering mechanism in public sector. More likely the public sector steering and decision making is still organised based on bureaucratic and new public management (NPM) (Levesqué, 2013; Moore & Hartley, 2008) that focuses on economic and technologist views of innovation and service and does not take into account their collaborative, interactive and dynamic nature. Therefore governance may be seen rather a problem producer than a problem solver (Voss et al., 2006) which may hinder the innovation activities in complex and continuously evolving society.

This critique reflects the broader paradigm change gaining ground in the governance system (Newman and Clarke, 2009). Although the benefits of hierarchical new public management based coordination are indisputable compared to the earlier bureaucratic view (Hartley, 2005; Moore & Hartley 2008; Levesqué, 2013) the limits of NPM have become apparent along with the development towards increasingly complex issues, involvement of multiple actors and need for open dialogue (Sørensen, 2002). The shift from hierarchical top-down "government" to more horizontally organised self-regulating networks of governance (Sørensen & Torfing, 2007) has been seen as a possible answer to the challenges posed by increasing societal fragmentation, complexity and dynamism (e.g. Levesqué, 2013; Moore & Hartley, 2008, Voss et al., 2007; Sorensen & Torfing, 2007; Hartley, 2005; Rhodes, 1997) and useful mechanism that supports the innovation development frequently along the continuously changing societal conditions (Voss et al., 2006).

However, because of the comprehensiveness of changes in governance it is not simple and immediately clear how to apply these transitions in practice (Shove and Walker, 2010). Resent literature have analysed the central aspects from the practical point of view to identify the factors which challenge the application of new governance culture (Showe and Walker, 2010; Moore & Hartley, 2008). According to the literature, fundamental problem lies in understanding the interaction between top-down and bottom –up approaches and co-creation with different actors and actor groups including the public private and third sector organisation not forgetting the central role of citizens in "doing" the change.

2.3. Public-private innovation networks (ServPPINs) in conducting the change

ServPPINs (Gallouj et al., 2013) have emerged as a result of the above described modernisation trends in the public sector (Di Meglio, 2013). They are reflections of novel forms of governance which focuses to the rise of networks and partnerships, innovations as a democratic practice, the development of "choice" and co-production of services and innovation (Langergaard, 2011; Newman & Clarke, 2009). ServPPINs embody flat and flexible types of organisations which aim to develop synergies between different knowledge, competences, interests, objectives and services that different partners bring in to the network (Gallouj et al., 2013; Di Meglio, 2013; Rubalcaba et al., 2013).

In the heart of the ServPPIn is the collaborative relationship between public and private sector partners. Compared to the traditional innovation networks, ServPPINs highlight the equal role of public sector service providers and manufacturing firms. Instead of having limited role in providing infrastructure, financing and institutional framework public organisations may be real co-producer of service innovation by initiating, organising and propagating new ideas (Di Meglio, 2013). Moreover to facilitate better matches between technology and demand ServPPINs involve consumers, intermediate users and third sector organisations to be active collaborators (Rubalcaba et al., 2013). Based on the empirical studies on ServPPINs (eg. Rubalcaba et al., 2013) their potential is in credibility, dissemination, speeding up the process of agenda setting and decision making, provision a more comprehensive view of the problems, legitimacy, resources and efficiency, learning capacity and knowledge transfer.

There are some key features which help to understand how ServPPINs operate. *Firstly*, they are grounded on a *broad concept of innovation* brought about by evolutionary economics (Nelson and Winter, 1982; Kline & Rosenberg, 1986; Dosi et al., 1988; Dosi, 1999) that highlights the dynamic nature and integrative perspective of innovations in which both technological and non-technological aspects have a crucial role. *Secondly,* they are formed as multi-agent frameworks (Windrum & Garcia-Coñi, 2008; Windrum, 2013) in which the variety of actors from the public private and third sectors is involved both in the innovation process and delivery of final service and in which each of the actors incorporate their specific competencies and interests into the innovation process. By engaging various actors in the different phases of innovation they may promote systemic change in sectors concerned (Weber & Heller-Schuh, 2013). *Third* aspect relates to the life –cycle perspective referring to the evolution of ServPPIN through different phases. Phases are design (1), pilot and imple-

mentation (2) and consolidation (3) which may affect to the dynamic and composition of ServPPIN. *Fourthly*, they are characterised by the open, complex, uncertain and interactive trust based (Fuglsang, 2013) process in which the several driving forces influence to the final outcome. The level of "formality" and structuring of relationships may vary, but typically certain degree of formalization in usually required (e.g. exploitation of intellectual property rights).

Djellal and Gallouj (2013) propose a typology of ServPPINs. The criteria used for the typology pays attention to the nature of innovation (e.g. tangible and intangible nature of innovation) and the characteristics in its' development process (planned and unplanned nature of development).

Table 1. ServPPINs according to their complexity (modified by author from Djellal & Gallouj, 2013)

Analytical dimensions	**ServPPINs according to their complexity**			
Type of ServPPIN	Simple ServPPIn to adopt technological innovation	Simple ServPPIN to co-produce technological innovation	Simple ServPPIn to co-produce non-technical innovation	Complex ServPPINs to adopt, produce and enhance implementation of complex architectural innovation
Type of innovation	Technological innovation		Non-technological innovation	Broad based, complex innovation including various technological and non-technological innovations
Dominant type of innovation process	Planned innovation		Unplanned innovation	Planned/unplanned innovation including both bottom up and top down innovations
Theoretical perspective	Assimilation		Demarcation	Integration

As set out in the table 1 four types of ServPPINs are identified: 1) simple ServPPINs set up to adopt a technology; 2) simple ServPPINs set up to produce technological innovation; 3) simple ServPPINs set up to produce non-technological innovation; 4) complex or architectural ServPPINs. These ServPPIN types are also related to traditional service innovation perspectives: assimilative (or technologistic), demarcative (or service-oriented), and Integrative (Gallouj and Weinstein, 1997).

3. Research context and methodology

3.1. Case context

The focus in the selected case-study is to provide information how recently established Finnish policy instrument SHOK – Strategic Center for Science, Technology and Innovation – operating in the area of environment and energy, promotes the systemic change and industrial renewal in energy and environment sector. Centres operate as not-for profit limited companies build on public-private partnership aiming to enhance collaboration and interaction between business life and academia over the traditional industrial sectors. Their main goal is to renew industry clusters and to create system innovations to meet the needs of Finnish industry and society within five-to-ten-year period.

In this case study our focus is in Cleen-SHOK (later Cleen) which aims renew the energy and environment cluster and to promote industry's competiveness in the area. Cleen has currently 44 shareholders including companies (28 in total) and universities and public research organisations (16 in total). The focus areas and operational activities are based on a strategic research agenda (SRA) jointly defined by the partners. The targets of the research agenda are operationalized through long-term research programs carried out in collaboration of research organisations, universities, companies and other actors. Funding for the programs is coming from multiple sources. An average fourty per cent is co-funded by partner firms involved in it, ten per cent by public research organization and the rest is coming from public funding providers such as Finnish Funding Agency for Innovation (Tekes) and the Academy of Finland. The SHOKs also apply to EU research programs for funding.

We examine specifically three ongoing research programmes and the preparation of two "second generation" programmes. The ongoing programmes are 1) *'Distributed Energy Systems'* (DESY) aiming to increase the production of renewable energy and the promotion the use of hybrid energy technologies, 2) *'Smart Grids and Energy Markets'* (SGEM) aiming to develop smart grid architectures and, intelligent management and solutions for smart consumption and customer interface. Interaction between ICT systems and energy systems is a central innovation behind the advancements in this area and 3) *'Measurement, Monitoring and Environmental Assessment'* (MMEA) that aims to develop an environmental information systems to monitor and evaluate the environmental efficiency of various industrial processes, products and infrastructures.Two programmes in preparation relates to the development of '*architecture of sustainable energy systems'* and *'healthy urban living'*. The former aims to provide holistic view needed for the energy system revolution towards sustainable and flexible system. Programme focus is on optimal integration of centralised and decentralised energy resources and production on system level as well as flexible use of various energy carriers (electrical networks, gas, heat, cool). The latter programme "healthy urban living" aims to increase urban resilience and well-being of citizens. It focuses on the interaction and interlinkages in urban system taking into account the energy chain, human behaviour, environmental and meteorological data, air quality and its effect on human well-being. It engages the citizens and enhances the co-production of urban system between different societal actors.

Cleen can be characterized as ServPPINs generating complex and architectural innovations (Djellal & Gallouj, 2013). Following table 2 describes our case context in the analytical dimensions of ServPPIN.

Table 2. Cleen SHOK as a ServPPIn

Analytical dimensions	Description	Cleen as a ServPPIN
Goal, type of innovation	Broad perspective to innovation; complex, architectural innovation including various forms of technological and non- technological innovations	Complex innovation to promote the systemic change and industrial renewal in energy and environment sector and to define e.g. "the new architecture of the future energy system". System renewal requires variety of technological and non-technological innovations; e.g. new patterns in production and consumption of energy.
Type of ServPPIN	Complex ServPPINs to adopt, produce and enhance implementation of complex architectural innovation Multi-actor network	Co-production of various forms of technological and non-technological innovations 44 shareholders representing private and public organisations and different parts of the system Multi-actor collaboration essential to co-develop new competences, to promote the creation of new business and industrial competitiveness and to enhance the implementation of complex innovations in the area of energy and environment
Dominant type of innovation process/ dynamic	Planned/unplanned innovation requires both bottom up and top down innovations developed both within formalized models and various informal models (e.g. bricolage & rapid application models)	Systemic change in energy end environment sector requires innovations in every level of society and is based on top down strategies and activities as well as bottom up activities and experiments. The systemic change is promoted by both by formalized and informal models of innovation.
Theoretical perspective	Integrative	Renewal of energy and environment sector is based on the collaboration of multiple actors representing the different sectors of society and on the integrative solutions combining multiple types of technological and non-technological innovations.

Regarding to the goals Cleen aims to tackle with prominent societal challenges, among which the environmental sustainability is primary. It accelerates new system level innovations and industrial renewal through new type of interaction and co-creation. The innovations developed in the network can be characterized as complex combinatory innovations encompassing both technological and non-technological ingredients and are developed in the collaboration between multiple actors.

3.2. Data collection and analysis

In order to gain an in-depth understanding of the governance in the case organisation, we gathered data from four types of sources. *The primary* instrument for data collection was face-to-face interviews (35 in total). The interviews were gathered between February and June 2013. Some complementary interviews were done in

spring 2015. We applied snowball sampling in the identification of interviewees: the first respondents were Managing Director of Cleen Ltd and the Programme Managers. Based on their suggestions, we thereafter selected the other interviewees among the members of the programme consortiums. The final sample represented actors in the area of sustainable energy and environmental measurement in a versatile way. It consisted of representatives of small and medium size companies (SME's) and large companies in the field of environmental measurement and sustainable energy. In addition the experts representing universities and other public research organisations in the same fields were interviewed. All interviewees were managers or senior experts in their background organisations and they had a significant role in the preparation and implementation of research programmes.Typically they were acting as program managers, work package leaders or they were leading the service demonstration development as a part of the programme implementation. Interviews were complemented during the spring 2015 by the interviews of technological and development managers of Cleen.

We applied a semi-structured interview method: the topics were decided beforehand but within them the respondents were given a great deal of freedom (Bryman and Bell, 2011). We structured the topics on the basis of our theoretical analyses in the areas of the systemic change and innovation in the area of energy and environment, governance and management of the innovation process in ServPPINs and roles and responsibilities of network actors in the innovation process. The duration of the interviews ranged from one and half to three hours. All interviews were recorded and transcribed.

Second source of material gathered were observations of new programme preparation process. We took part in six collaborative workshops which were directed to company, university and research organisation participants to work on new research programmes. Workshops took place during the spring 2014 (February-May). During the meetings we wrote up field notes based on the discussions. To complement the field notes we had access to the official minutes of meetings, which were provided by the case organisation.

Third source of information is the material provided during the preparation phase of the new programmes. Thanks to our access to the digital working space we were able to follow the programme documents and other material provided in the course of programme preparation. *Fourth* information source we have utilized is the strategic documentary material provided by the case organisation. These include, for example, the strategic research agendas, guidelines and criteria for the programme preparation, annual reports and programme result material.

4. Research results

4.1. Tackling the societal challenges in the collaboration of multiple partners

Based on our data, Cleen Shok is one of the central actors in the Finnish innovation system to tackle the above described environmental challenges and enhance a systemic change in the energy and environment sector. The role of research pro-

grammes has perceived to be especially important in the creation the comprehensive picture of the required transition, in the definition of strategic research questions and in the identification the central actors who are needed to solve the identified problems and thus to enhance system level change.

According to our interviews the empowerment of multiple actors representing variety of sectors, competences and world views is in essential role both in creating holistic understanding of the requirements of system level change and in developing solutions that correspond with these comprehensive needs. They highlighted that the novel programs have accelerated the network generation over the traditional organisational boarders and have thus enabled the generation of strategic understanding and development of completely new competences required for the systemic change. For example in the SGEM programme interaction between energy and ICT systems is in central innovation behind the advancement of novel smart energy infrasturcure. Like revealed in interviews in face of complex and systemic problems actors are running out of competence and are not capable of handling systemic problems without the support of broad based network:

> *"Understanding the ongoing change is anything but a linear process. To create general understanding we need multiple organisations, multiple actors, multiple backgrounds. One actor understands this and other actors that and together we are able to create a holistic view of the ongoing changes. Without the collaboration of many actors the creation of strategic view is no possible. For that reason we did not have strategic understanding of the ongoing changes in energy sector before the first SHOKprogramme period". (Representative of university A)*

> *"We are running out of competence alone regarding the systemic transition in the energy and environment sector. Thus we need to have variety of playmates who have different types of competences required for the creation of holistic understanding of the ongoing change" (Representative of large company A)*

However, compared to traditional research and development programs collaboration between multiple partners and over traditional sectoral boarders also complicates the structure of networks. For example in the SGEM encompasses in total 21 industrial partners from energy sector including for example energy technology providers, power production companies, energy distributors, energy sector service providers and from ICT sector including for example software developers, network providers and network safety consultants. In addition eight partners representing universities and public research organisations are in the core of the network. And in the first preparatory workshops of new ´healthy urban living' -programme approximately hundread participants representing variety of public, private and third sector organisations took part. Although the structure is complicated, the interviews revealed that extensive participation ensures both the system level problem solving and real co-creation.

> *"On the one hand traditional research programs are more clear and simple in their structure, but on the other hand they have not managed to incorporate all the actors needed for the system level problem solving. In addition traditional research programmes lack of real will and capacity of co-creation. By empowering all the central national partners SHOK programmes have man-*

aged to create a forum for real collaborative innovation " (Representative of public research organisation A)

Although in all the interviews multi-actor collaboration was commended the central notions regarding the participating actors is the abundance of research and company actors and absence of other public sector authorities, municipalities and citizens. Interviewees agreed that in the first generation programs the focus has primarily been in development of new technologies and solutions. Instead the broader understanding of citizens' needs and societal aspects has been lacking. They admitted that to create comprehensive understanding of the healthy urban living conditions or the requirements of novel comrehensive energy architecture, new actors and competences need to be incorporated in the programs networks. Like revealed in interviews understanding the function of political and social systems including the power relations and consumer needs and behaviour are in crucial role in order to support acceptance of novel solutions and enhance the systemic change.

"To tackle the ongoing transition in energy sector we need to incorporate the competences and perspectives of multiple actors. Technology is the easiest part of the transition. To really be able to tackle the complex needs of system change we need to incorporate new actors and competences into our network. We need to have understanding of the energy as a political issue. In addition we need to understand what customers really need and how do they behave. When we have comprehension of these societal aspects of energy and their dynamic interaction in the system we may be able to develop viable and comprehensive service solutions and novel business concepts. (Representative of university A)

Interviewees admitted that the program actors are just awakening to the need of sociological competences and that in the next generation programmes new competences need to be incorporated to broaden the perspective to systemic change. Based on our observations in the preparation of the "second generation" programs the centrality of citizen centric approaches and participation of public authorities have been taken into account. For example in the currently ongoing preparation of healthy urban living –program the behavior and need of citizens and role of municipalities as service development "platform" have been taken into account in strategic research agenda and attendees of the programme.

Like highlighted in interviewes broadening the collaboration is crusial not only for the development but also for the implementation of better and viable solutions. The most of the actors were confident that the active participation of companies and complete value chains in the programs supports the practical implementation of the results, which is required for the systemic change. The actors believed that the evidence gained through pilots and demonstrations carried out in ongoing programs manifests also successfulness of the programs and support the systemic change.Like the citation below illustrates specially the co-development with large companies was seen crucial because of the ability to enhance the change also through companies strategies.

"To really make systemic change happen it is important to have large companies in these networks. They are also capable of enhancing the transition through their organisational strategies and programs" (Representative of large company A)

However, the success on SHOK-programs is manifested only if the new knowledge and innovations developed in the programs can be executed as nationwide decisions and implemented for example as new structures for energy production system and healthier urban architectures. Like some of the interviewees regretted currently the application of the research results in real life situations is too slow. One reason given is the above described insufficent collaboration with users. Besides an inadequate communication with desicion-makers was seen as a bottleneck for insufficient implementation of the results. Although, several program actors were active in collaborating with national and local policymakers and some of the actors were participating in EU and national working groups, the interviewees called for more systematic collaboration with decision makers. Like interviewees revealed, to really enhance the systemic change more influence on decision-making and more systematic collaboration with the policymakers and other interest groups are needed.

> *"Currently the actors have produced lot of paper. But nothing is really happening if we don't have courage to implement the results. Now the research is going round in circles. Instead we should be thinking how and with whom we implement the results as practical and concrete solutions and changes" (Representative of a small company A)*

> *"We should be more active in communicating our research results to decision-makers. Single actors have been active in contacting national decision-makers and politicians. This is are very important if we want to have an influence and impact in society. Hoverer, we should be much more active in national and EU-level vision work to really have influence on the future developments." (Representative of large company B)*

4.2. Creating new competences and business solutions in a trust-based collaboration

As shown above, programs have managed to create a model for a network type of collaboration which integrates variety of competences and actors needed for the enhancement of systemic change. According to our empirical data the innovative network structure and ist' ability to create novel competences is based, on the one hand, on the formal contracts and partnerships and on the other hand on the deep-going trust based collaboration which has been systematically facilitated by the Cleen and programme personnel. According to the interviews parters' role as formal shareholders is a good way to ensure the commitment and success of network collaboration. In addition the collaboration is regulated by formal contracts and intellectual property rights. However, their role in collaboration is reported to be less meaningful than the role of informal trust, which was highlighted in all interviews in attaining open and profound collaboration. Like one interviewed representative of university B pointed out *"without trust the collaboration is limited only to the change of informatio*n".

Informal trustbuilding has been systematically facilitated from the beginning of programme planning. According to our observations, Cleen has an active role in the matchmaking new partnerships and in the creation the forum for open and trust-based discussion. They organise an open call for multiple stakeholders to take part into the creation of research agenda in the series of workshops. By organising the workshops aim is to give voice to multiple partners' needs and to match companies

and research actors over traditional sectoral boarders. According to our data, setting the common targets and planning the practical implementation in the interactive and collaborative process, weld the partners together from the beginning.

The operational principle of Cleen defines that programmes are industry driven meaning that the industry needs are high on the research agenda and the targets are mainly set by the stakeholder companies. Like one large company (B) representative revealed *"thanks to the novel programmes company targets are high on the agenda, whereas in the traditional research programs funding is directed to research done in ivory towers".* Our informants considered that the companies' will and ability to sit on "a driver seat" commit them into the network and is a core issue when aiming for a profound collaboration. However, interviewees also highlighted the centrality of research partners in balancing the longer term strategic research competences and shorter term business opportunities. Like the following sitations demonstrate the combination of different type of targets enhances the understanding the other parties' objectives and thus benefits the collaboration.

> *"This new instrument has created condition for true and open collaboration over company boarders. Partners sit in the same meetings to set targets for the common development and they implement targets collaboratively. Companies are actually affecting the target setting and thus the company and user needs are taken into account in research and development work. Also our research partners have benefitted from the collaboration – they have said that now they understands better what are company needs and what are the challenges that need to be solved. In the best case this operational model generates an innovative platform for variety of organisations willing to tackle collaboratively our common societal problems." (Representative of large company A)*

> *"Programme instrument includes variety of actors from research and industry and it have managed to combine the long term visionary research work and concrete short term business objectives. The combination of different types of targets is essential for good trustbased collaboration and relevant to tackle system level problems." (Representative of large company B)*

According to interviews profound and trust based collaboration has been a stone base leading to new combinatory competences and the creation of integrative service solutions. Programs have for example generated the new type of coproduction between experts from energy and ICT sectors and thus facilitated the generation of comprehensive energy architecture. New combinatory competences have for example made possible the coexistence of centralised and distributed energy systems and guaranteed the safe energy flow in the system. In addition, by combining ICT in the energy system, programs are making possible to multiple actors to design, construct, steer and use the smart and flexible energy system in future. Like one large company (A) representative illustrates novel combination of competences and helps in tackling the challenges in the energy and environment sector. *"We have generated completely new competences with completely new partners. This creates a ground for a completely new industrial sector".*

Novel combination of competences generates new strategic partnerships and gives a room for practical pilots and demonstrations. It benefits both companies and research partners. For example actors who develop platform for sharing environmental data

experience that the program has given rise to new knowledge cluster which has both ameliorated the scientific base in the area and supported the development of concrete business solutions. Like citations below illustrates close collaboration has led to the interdependence between partners. It has changed the way of thinking and doing business and has given rise to novel ecosystems. In addition it has is seen to be in strategic importance in ensuring the long-term business opportunities, in strenghtening companies competitiveness and in facilitating their entrance into the international markets.

> *"Shok programmes have generated new type of collaboration between company partners. We have learned to collaborate fluently and openly with other companies which is not typical way of action in business. It has strategic importance for us and gives us a competitive advantage in markets five or ten years. It the future the firms who do not have the same capacity stays alone and focuses to the own narrow doings. These company networks are extremely important in the internationalisation of business. We cannot fight Chinese alone, but we can compete with them in the well-functioning company networks. Collaboration strengthens our competiveness domestically and internationally" (Representative of large company A)*

> *"For our company this programmes has been extremely important. It has especially supported our internationalisation into China. In Europe it is easy to operate for our type of small company. On the contrary it China operating alone is not possible. Without the support we get from this public-private innovation network if would be impossible to create business in China." (Representative of small company B)*

Building a trust based relationship and creating completely new collaborative ways of working is essential but not a simple issue. On the contrary it is time consuming work which is based on systematic and open interaction, recognition of common interest and value added of each party in the development. Learning to speak common language and having the shared working methods cannot be adopted immediately into the organisations. On the contrary it requires changes in mindset and ways of working. Single organisations need for example to adopt the idea of shared value which again affects the operational model and business logic in entire organisations and business networks. Although the needs for change were ambitious interviewees underlined, that the first generation programs managed to generate shared working methods and to increase understanding of the co-production of value when tackling the complex societal challenges.

4.3. Supporting the multi-actor collaboration by steering and governance mechanisms

Programmes are steered by multiple mechanisms and in different phases of their implementation. The most part of funding is coming from Tekes, who is both setting the criteria for funding and following the success of programs based on continuous reporting and evaluation. In addition Cleen is monitoring the success of the programs. According to interviews the double steering only increases bureaucracy and does not improve the program results. However it was seen as a small and bureaucratic snag: the bigger problem according to our empirical data is the governance criteria and

mechanisms of funding organisation which do not take into account the systemic nature of the programmes. The problem manifests as contradictory and mechanistic targets of evaluation, bureaucratic preparation process and restricting consortium rules.

Like discussed above, programmes aim to find solutions to complex environmental problems. A paradox when setting programme targets is to match them up to funding criteria which do not take into account the complex and systemic nature of the programmes. Criteria set by funding organisation are based on the linear view of innovation which emphasises the short term results such as publications, patents, computer softwares and new products. Long term systematic changes emerging in the collaboration of variety of actors are not taken into account. Like interviewees highlighted the problem in steering reflects the absence of good measures capable of capturing the integrative nature of solutions and their dynamic development process.

> *"The traditional evaluation and steering is based on concrete outputs of programs such as publications, softwares. But what we are actually developing is comprehensive and holistic understanding to support the societal transition in energy sector. Programs support the new ways of thinking and new societal structure, but how to measure these types of changes. It is paradoxal that there are no good measures for these systemic innovations. At the same time it is understandable that good measures do not exist yet. The changes would not be innovative and revolutionary if there were already measures for these changes". (Representative of University representative B)*

> *"Problem in steering of the programs is the traditional measures and indicators. Funding organisation is still focusing for example on the numbers of developed products or reviewed articles. We should report how many new products we have launched during the programs period and how many articles we have written. But the answer is none. Because this was not set as target. The targets for the programs are something completely different but the current measures are not able to capture the program targets which are much more holistic that these current measures. (Representative of large company C)*

Problems in understanding the systemic nature of the development and challenges in finding good criteria are seen, from the viewpoint of programme participants as contradictory targets. On the one hand programs are supposed to be risk taking and renew industrial structures in a long term but on the other hand the indicators to measure their succes remains rather concrete and highlights mechanical outputs. In concrete terms funding organisation for example expects short term readiness to launch new products and services into markets. However, according to the criteria conrete service and technology development in the programmes is denied. Like citations below illustrate the conflicting criteria make the preparation of the programmes schizophrenic and causes uncertainty about the role of different actors in governance of network.

> *"Problem is the contradictory funding criteria set by Tekes. On the one hand we are expected to promote export activities but on the other hand we are not allowed to do any service or project development. Steering is schizophrenic because of contradictory and too mechanistic targets (Representative of small company C)."*

”Current steering is based on contradictory targets. On the on hand the programs need to be long term and risk taking and on the other hand programs should provide concrete short term results. I don’t know if I should laugh or cry when thinking which targets to follow. Funny thing is that Tekes has denied us to develop concrete products, anyhow they are having it as a success indicator because they do not have any better indicators. But how can you get something which has not been set as target? Furthermore the steering culture is very much dependent on the personal opinions of person in charge in funding organisation. During our programme preparation the person has changed for three times and every times that has affected to the emphasis of our program. The former stressed completely different things than the current.” (Representative of university A)

Also the timescale in steering was criticised by programs actors. Enhancement of systemic changes such as the emergence of user communities to support the acquisition of real time environmental data and developing concrete business solutions for environmental reporting standards is a complex and long term process. The timeline for these changes is much longer which can be captured by the current evaluation and steering mechanisms. Therefore the reported results do not tell the truth of the attained results. Like revealed in interviews current steering may direct to wrong conclusion of success of of the prgrammes:

”Current indicatior in steering may lead to the completely wrong conclusion of the success of the programs. They may even show that companies have not achieved anything in these programs. The reason for the wrong conclusion relates to the different time scales of steering and productisation in companies. Launching the new products is a long term process. Companies publish the information of new solutions when launching them. Problematic thing is that steering in funding organisation is based on targets which do not take into account different timescales. We have, for example, started several the product development processes based on the program results, but we won’t tell about these results in public before we are launching the new products.” (Representative of a large company D)

Current criteria are set top-down by funding organisation. Instead of top-down target setting programme actors are begging for better interaction with funders during the programme preparation and implementation. According to them it would be essential to have a shared vision created in the dialogue between top down and bottom up processes. In addition the operational environment in continuously evolving thus the targets and operations of the programs need to be adapted into the changes in operational environment. That also highligts the need for continuous interaction. Role of funders in the process should be a supportive and collaborative partner, not a controlling administrator. Like revealed in interviews, aspects to be considered in the vision building are the holistic understanding of the forthcoming environmental challenges and users‘ needs. Equally important is to identify both the most relevant actors and the central milestones required to realise the vision.

“Funding decisions are made currently in a very bureaucratic process and the selection of programs is based on completely wrong criteria. They are focusing too much formal structure of the proposal although the focus should be in visi-

onary targets: how we aim to enhance societal change in collaboration. The bureaucracy and control not enhance the good quality research, business impacts or industrial renewal in this country. On the contrary when we are aiming at radical and long term change the objectives should be defined in the collaboration of multiple actors including funding organisation. Together we should set targets and identify the steps to reach targets." (Representative of large company E)

Interviewees believed that open interaction with funders would improve the program preparation. Currently the preparation processes are typically prolonged because of the bureaucracy, lasting in some programs even for five years. Un-effective preparation has led to fatigue of company partners and some of them have decided to opt out from the consortium. Loss of the central partners has led, like illustrated in citation below, to the absence of required competences:

"Preparation process of new programs is untenable. Long and hard preparation has led to the situation in which the company partners have decided to opt out of the project. Instead of refining the proposal in details the focus should absolutely be in setting long term visionary target and ensuring that we have the best actors in our partnership network" (Representative of University C)

Not only the poor evaluation criteria and interaction in governance, but also the consortium rules are limiting the agile collaboration and network formation. Current rules are inflexible and do not correspond with the modern way of development which is based on continuously evolving networks. However, current consortium rules necessities permanent participation and do not allow the evolvement of networks which may congeal programs activities. For example programs actors perceived the need to empower the citizens and residents' associations into the development of energy solutions in ongoing programmes. However, integration of new actors during the programme period was not possible which complicated the program implementation and prevented the empowerment of citizens. In addition, in some companies, for example in start-ups and high growth companies the operations are fast and cycle, which are not recognized in the consortium rules. Thus their participation in the programs may be prevented by too strict consortium rules. Like the citation illustrates our interviews assume that more flexible consortium rules would facilitate company entry and participation in the programs.

"Consortium rules in programmes are problematic and prevent the flexible entry into and exit from the programs. More flexible rules would facilitate the small companies' participation. Now the rules are old-fashioned and they do not support the cyclic and fast operations of start-ups and high growth enterprises in which the phases of research and commercialisation alternate flexible in the course of development process." (Large company representative D)

Current consortium rules also constrain partners collaborate within national boarders and hinders the collaboration with the foreign actors whose competences would be relevant in providing high level research and completely new solutions. Like interviews revealed the consortioum rules should be renewed to support the collaboration with the relevant partners instead of being restricted on national borders:

"China has changed the criteria of innovation activities and they allow the R&D funding abroad. We should also renew our rules in Finland. The current rules restrict the collaboration with international partners which prevents the collaboration and co-production with the world leading partners and stagnates the national competence development. It is impossible to imagine that in Finland you can continuously find partners who are the world's best in everything. When you try to collaborate in these programs with foreign researcher funding organisation says that we cannot pay the salary for researchers in Chinese universities. I do see why it is difficult to renew the rules; they are only afraid of nasty headings in newspapers that Finland is funding the R&D in China." (Representative of small company B)

5. Concluding discussion

In this paper we have examined the collaborative forms of service innovations to tackle the system level challeges in environmental sector. To describe multi-actor collaboration we have applied the concept of ServPPIN (Gallouj et al, 2013). It concretize forms of such new governance approach in which the solutions to complex societal problems are based on the integration of technological and service based novelties, and which appreciate innovation as a democratic practice as well as partnerships, co-production and trust between multiple kinds of actors.

Innovation dynamics within an ServPPIN are result of complex interactions between various actors having heterogeneous competences and goals (Djellal and Gallouj, 2013). The perspective of social innovation is applied to create understanding of the participatory and networked processes without which it is not possible to create innovation in a multi-actor environment (see. Toivonen, 2015; Harrisson, 2011).

Our case study reflects in many ways the complex ServPPINs aiming to enhance systemic change in the area of energy and environment. It developes complex, architectural innovations (see Djellal & Gallouj, 2013) to promote the systemic change and industrial renewal in the sector for example by defining the "new architecture of the future energy system". System renewal requires variety of technological and non-technological innovations; e.g. new patterns in production and consumption of energy. Besides new technologies, new services, business models and processes (in and between different levels of society) are developed.

Renewal and system level change is accelerated through new type of interaction and co-creation within multiple network partners. According to our results the empowerment of multiple actors representing variety of sectors, competences and world views is in essential role both in creating holistic understanding of the requirements of system level change and in developing solutions that correspond with these comprehensive needs. However in the collaboration the representives of public and private sectors are dominating. Instead the broader understanding of citizens' needs and societal aspects are lacking. That may hinder the acceptance of novel solutions and hamper the systemic change.

Development process on the complex innovations include formalised top down strategies and regulations. Like the results show the emergence of an open and collaborative culture is crucial to the development of such a network; the core is in informal

models of innovation by giving room systematic procedures of building trust. Organisational boundaries need to be opened up to facilitate the collaboration and integration of various competences and divergent goals. These characteristics of network imply the need for development of a different set of competences, resources, and expertise, as well as different modes of communication, coordination, and governance in the different level of system. Especially the formal steering mechanisms should be developed to understand the dynamic and long-term nature of systemic changes and to enable the complex development processes in networked world.

References

Di Meglio, G. (2013): The Place of ServPPINs in the range of pulic-private collaboration arrangements for service provision. In Gallouj, F., Rubalcaba, L. and Windrum, P. (Eds.). Public-private innovation networks in services. Edward Elgar, pp. 59-87.

Dosi, G. (1999): Some notes on national systems of innovation and production, and their implications for economic analysis, in Archibugi, D., Howells, J. and Michie, J. (eds.): Innovation Policy in a Global Economy, Cambridge: Cambridge University Press.

Dosi G.; Freeman C.; Nelson R.; Silverberg G. & Soete L. (1988): Technical change and economic theory, Pinter Publishers

Elzen, B.; Geels, F.W. & Green, K. (2004): System Innovation and the Transition to Sustainability, Edward Elgar, Cheltenham and Northampton.

Fuglsang, L. (2013): Collaboration and trust in a public-private innovation network: a case study of an emerging innovation model. In: Gallouj, F.; Rubalcaba, L. & Windrum, P. (Eds). Public-private innovation networks in services. Edward Elgar, pp. 247-264.

Gallouj, F. & Weinstein, O. (1997): Innovation in services, Research Policy, 26 (4/5), pp. 537-556.

Gallouj, F. (1994): Economie de l'innovation dans les services, Editions L'Harmattan, Logiques. Économiques, Paris.

Gallouj, F. (2002): Innovation in the service economy: The new wealth of nations, Edward Elgar.

Gallouj, F.; Rubalcaba, L. & Windrum, P. (2013): Public-private innovation networks in services. Edward Elgar.

Gadrey, J. (2010): The environmental crisis and the economics of services: the need for revolution. In: Gallouj, F. & Djellal, F. (Eds.), The Handbook of Innovation in Services. A Multi-disciplinary Perspective, Edward Elgar, Cheltenham, UK, pp. 653-673

Geels, F.W. (2002): Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. Research Policy, Volume 31, pp. 1257–1274.

Geels, F.W. (2004): From sectoral systems of innovation to socio-technical systems. Insights about dynamics and change from sociology and institutional theory. Research Policy, Volume 33, pp. 897–920.

Geels, F.W. (2005): “Processes and patterns in transitions and system innovations: Refining the co-evolutionary multi-level perspective”, Technological Forecasting & Social Change, Vol. 72, pp. 681-696.

Geels, F.W. (2010): “Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective”, Research Policy, Vol. 39, pp. 495-510.

Harrison, D.; Klein, J-L. & Browne, P.L. (2010): “Social innovation, social enterprise and services”. In: Gallouj, F.& Djellal, F. (Eds.), The Handbook of Innovation and Services, Edward Elgar, Cheltenham and Northampton, pp. 197-281

Hartley, J. (2005): Innovation in Governance and public services: past and present. Public Money and Management. 25; January, pp. 35 - 42.

von Hippel, E. (2005): “Democratizing Innovation”, MIT Press, Cambridge Mass.

Høyrup, S. (2012): “Employee-driven innovation: A new phenomenon, concept and mode of innovation”, in Høyrup, S., Bonnafous-Boucher, M., Hasse, C., Lotz, M. and Moller, K. (Eds.), Employee-driven innovation: A new approach. Palgrave Macmillan, New York, pp. 3-33.

Kesting, P. & Ulhoi, J.P. (2010): ”Employee-driven innovation: extending the licence to foster innovation”, Management decision, Vol. 48, pp. 65-84.

Kline, S.J. & Rosenberg, N. (1986): “An Overview of Innovation”. In: Landau, R. & Rosenberg, N. (Eds.): The Positive Sum Strategy – Harnessing Technology for Economic Growth, Washington D.C.: National Academy Press.

Langergaard, L. (2011): “Understanding of ‘users’ and ‘innovation’ in a public sector context”. In: Sunbo. J. & Toivonen, M. (Eds.) 2011. User-based Innovation in Service. Edwards Elgar Publishing, Cheltenham, UK, pp. 203-226

Lévesque, B. (2013): “Social Innovation in governance and public management systems: toward a new paradigm?” In the Moulaer, F., MacCallum, D., Mehmood, A., Hamdouch, A. (Eds.) The International Handbook of Social Innovation. Collective Action, Social Learning and Transdisciplinary Research. Edward Elgr, Cheltenham, UK, pp.25-39.

Meadowcroft, J. (2009): “What about the politics? Sustainable development, transition management, and long term energy transitions”, Policy Sciences, Vol. 42, pp. 323-340

Moore, M. & Hartley, J. (2008): “Innovations in Governance”. Public Management Revview, 10:1, 3-20.

Nelson S. & Winter R. (1982): “An evolutionary theory of economic change”. Cambridge (Mass.), Belknap Press/Harvard University Press.

Newman, J. & Clarke, J. (2009): “Public, Politics and Power: Remaking the Public in Public Services”. Sage Publications, London.

Rubalcaba, L.; Michel, S.; Sundbo, J.; Brown, S.W. & Reynoso, J. (2012): “Shaping, Organizing and Rethinking Service innovation: A multidimensional Framework”. Journal of Service Management, Volume 23, Issue 5, pp. 696 – 715, ISSN 1757-5818,

Rubalcaba, L.; Di Meglio, G. & Gallego, J. (2013): “Public-private innovation networks and social innovation in the service economy”. In: Viñals, C.R. and Rodríguez, C.P. (Eds.), Social innovation: New forms of organization in Knowledge-based societies, Routledge, New York, pp. 188-205.

Shove, E. & Walker, G. (2010): “Governing transitions in the sustainability of everyday life”. Research policy 39 (2010), 471-476.

Smith, A.; Voss, J-P. & Grin, J. (2010): “Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges”, Research Policy, Vol. 39, pp. 435-448.

Sørensen, E. & Torfing, J. (Ed.) (2007): Theories of Democratic Netwokr Governance.Palgrave Macmillan, New York, US

Sørensen, E. (2002): “Democratic theory and detwork governance”. Administrative Theory and Praxis 24(4), pp. 693-720.

Sundbo, J. &Toivonen, M. (Eds.) (2011): “User-based innovation in services”.Edward Elgar, Cheltenham and Northampton.

Voß, J-P.; Bauknecht, D.; Kemp, R. (2006): “Reflexive Governance for Sustainable Development”. Edward Elgar, Cheltenham, UK.

Weber, M.; Heller-Schuh, B. (2013): “ServPPINa as instrument for realizing system innovations: two case studies in passenger transport in Austria”. In: Gallouj, F.; Rubalcaba, L. & Windrum, P. (Eds). Public-private innovation networks in services. Edward Elgar, pp. 384-408

Weber, M.; Hemmelskamp, J. (Eds.) (2005): “Towards Environmental Innovation Systems”. Springer, Heidelberg.

Windrum, P. (2013): “Multi-agent framework for understanding the success and failure of ServPPINs”. In: Gallouj, F.; Rubalcaba, L. & Windrum, P. (Eds). Public-private innovation networks in services. Edward Elgar, pp. 88-112.

Windrum, P. & García-Goñi, M. (2008): “A neo-Schumpeterian model of health services innovation”. Research Policy, 37 (4), 649-672.

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