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Innovation architecture of renewable energy solutions pilots in Oulu

InnoCity project case study

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VTT

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ISBN 978-951-38-8189-4 (URL: http://www.vtt.fi/publications/index.jsp)

VTT Technology 195

ISSN-L 2242-1211
ISSN 2242-122X (Online)

JULKAISIJA – UTGIVARE – PUBLISHER

VTT
PL 1000 (Tekniikantie 4 A, Espoo)
02044 VTT
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Preface

This case study on Renewable Energy Solutions in City Areas (RESCA) is a part of Tekes-financed InnoCity project, lead by Senior Researcher Ville Valovirta from VTT Technical Research Centre of Finland. The research team of this case study comprised Research Professor Pekka Leviäkangas from the University of Oulu, and Research Scientist Aki Aapaoja and Senior Research Scientist Veli Möttönen from VTT.

The analysis work was kindly supported by the officials of City of Oulu from its Urban and Environmental Services: Mr. Aki Töyräs and Mr. Pekka Seppälä. The acknowledgement is extended to many other city officials involved in InnoCity project as well as to many of our project colleagues.

The InnoCity project is aiming at identifying the key points and challenges related to urban innovation processes and their scaling-up. The particular cases of InnoCity are selected on pragmatic grounds, while ensuring that relevant research questions are addressed. RESCA case of Oulu was qualified because of number of reasons. First, RESCA process has been in place for a while making it possible for the researchers to take look at recent history and have empirical material and observations. Second, the case fulfilled the needs of the city's officials, providing them an opportunity to have some analytical feedback on their activities and efforts. Third, the case fell within the scope of InnoCity project quite well.

The reports structure is as follows: it starts with an introduction including also the aims, scope and the used research methods (Chapter 1 and 2). The introduction is followed by the theoretical part that focuses on innovations and urban innovations (Chapter 3) but in particularly on urban innovations and generic innovation processes (Chapter 4). Chapter five and six forms the empirical part of this research. The fifth chapter introduces the case study, (i.e., RESCA) but it also takes a look on the strategies and goals of the city of Oulu that has had a major impact on both RESCA and the development activities at Oulu in general. The chapter six contains the main findings of this by focusing on the processes and the trajectory of the Oulu Building Supervision Office in order to reveal the points and spots that make this case and the processes in RESCA and the city of Oulu so special. The last chapter presents the results findings and discusses the position of RESCA from the innovation typologies and innovation scalability point of view.

All the conclusions and interpretation of analysis is entirely those of the authors.

Contents

1. Introduction

Innovation is on the agenda national and local governments, large and small companies, a vast number of institutes covering different sectors and research as well as universities. The reason for this is simple: innovation is needed to survive competition, be it of whatever nature. Business, commerce, research, public services, competitive advantage of nations, etc. are all dependent on how well they manage their resources and create added value in an ever competitive world.

The added value can mean different things to different stakeholders and it is typical that innovation seeks a step forward for the stakeholder in question. Companies on consumer markets are finding ways how to create products and services that are selling better than their competitors. Public sector agencies are prospecting how they would be able to serve citizens better in the context of shrinking or non-growing budgets. Research communities need to generate new understanding, technologies and knowledge to serve mankind – or as in many occasions, to satisfy their financiers, both public and private.

The pace of innovation cycles is speeding up. From new concepts and ideas marketable or usable products and services are expected to be refined in a relatively short time. This has brought forth the need to manage innovation rather than just fostering it. It can be debated with justification that the combination of words “innovation” and “management” is somewhat questionable. It is often claimed that innovations cannot be managed. Perhaps so; however, it is equally fair to postulate that some environments, management models, and work processes are more likely to generate innovations than others. Although innovations may occur in garages, they are more likely to take place in cities with research institutes and universities than in cities without such premises.

Urban innovation is innovations in urban environments and contexts take place – or are applied in – cities and urban communities. Urban innovation is perhaps particularly interesting concept as we face many grand challenges that relate to urban areas: social equity, transport problems, public service quality, and environmental damages. These are of course resulted in by urbanisation and increasing population densities to the extent where outdated urban structures and organisation models do not work effectively any more.

This report presents an analysis of one effort to tackle one particular urban challenge: energy efficiency and climate change. The context is Renewable Energy Solutions in City Areas (RESCA) and northern Finland, city of Oulu. RESCA

project aimed at paving the way for more sustainable energy solutions in a new urban development area. We examine the process how RESCA was taking shape and assess the successfulness of the approaches adopted. Particular interest of this report is on the scaling-up potential of RESCA's proceedings and outcomes. Also the project is mapped against more generic innovation models and frameworks.

2. Aims, scope and methods

2.1 Aims and objectives

The aims of this case study are as follows:

- to describe the chronological and critical steps of RESCA project in the city of Oulu
- to assess how these steps are in line with more generic descriptions of innovation processes
- to assess the successfulness and concrete outcomes of RESCA project in Oulu.

Through the aforementioned aims the higher level objectives are pursued. The first objective is to assess the entire innovation process of Oulu's RESCA and to evaluate the innovation processes worked in Oulu's RESCA and how different actors were associated and engaged with these processes. By following the history of Oulu's RESCA the attempt is to identify where the process worked successfully and where the weaknesses might have lied. Ultimately, the answers are provided by the researchers' subjective judgement.

The second objective is to assess both the process and the outcomes of Oulu's RESCA in terms of scaling-up potential and challenges. The process itself comprises actions, measures and resources provided by the engaged actors. Some of these actors are in the very core of the processes and some are in outer tiers. Hence, the "relevance" of actors varies depending on stage of the process and the role the actors are having in these stages. The outcomes are also somewhat vague in definition. They might be physical new products, new service concepts or just sometimes better understanding of the problems at hands, whatever these may be.

Third objective is to gain better understanding of urban innovation processes and management. It might be questionable to claim that innovations can be managed at all, and not all new things are innovations, be they processes, products or services. For this objective, more generic innovation process descriptions are

used as a benchmark and the processes of Oulu's RESCA project are reflected against them.

2.2 The scope

This case study focuses on one particular sub-project of a larger programme (RESCA). Also the geographical scope is limited to one city, and one housing area. However, since the largest cities in Finland share common features in terms of size, demography, infrastructure and social structures, the generalisation of results and conclusions is most likely feasible throughout the country. Smaller cities with the abovementioned characteristics being quite different, are however a story of their own and the results and conclusions should be viewed this fact in mind.

Also the urban planning processes are dictated by law and hence standardised to a large extent. This allows the results to be scaled-up to almost any urban planning environment.

2.3 Methods

The research process was divided in to the following sections:

- review of empirical material and literature (RESCA-case materials, literature, etc.)
- description of innovation and planning processes side-by-side
- validation meetings with city officials and other actors
- synthesis and conclusions

The literature review was carried out by the research team (i.e. the authors) and through student assignments at Industrial Engineering and Management in University of Oulu under the supervision of Dr. Aapaoja and prof. Leviäkangas.

The innovation processes used in literature were applied so that the processes and approaches adopted in RESCA case. Some more generic innovation models and frameworks are used to map or position RESCA as a structured innovation effort. The goal is to identify where in particular RESCA proved to be successful (and where perhaps less so) and how these observations feedback in to innovation funding and innovation management.

All along the analysis process frequent meetings and correspondence with city officials responsible for RESCA were kept. This way, the researchers attempted to validate their observations and conclusions.

3. Urban innovation

The most of the world's population is living in the cities. The turning point in which more than half of the world's population (approximately 3.3 billion) are living in urban areas was achieved in 2008, and by 2050 the number is expected to enlarge to 9.6 billion (United Nations 2013). The rapid urbanisation will increase the risks and challenges that cities will face, for example air pollution or enormous unemployment. (Nam & Pardo 2011). According to Johnson (2007), "social and environmental problems related to city growth can be serious threats to the full realisation of the socio-economic contribution that cities can make". Simply, to deal with challenges faced in urban areas, the creation of urban innovation is necessary.

Figure 1. Perceptions on sustainable cities (left: artist's impression on Dubai Sustainable City; source: *http://www.emirates247.com*; right: Sweden's Sweeping Green Roofed Hillside City; source: http://inhabitat.com).

Cities are also known as engines of innovation. They play a key role in social and economic development. (Johnson 2008.) There is no huge range in number of innovation, in proportion to population of town, between city and rural areas. Though the innovations made in the university towns were more complex than elsewhere. The city areas also were differentiated. For example, two thirds of innovations in knowledge incentive service sector are produced in Helsinki area.

(Valovirta et al. 2009.) Johnson (2008) gives some explanations why cities are innovative. There are both supply side and demand side arguments. On the supply side, cities have better factors for production (capital and labour) and better infrastructure. In addition, the production structure in the cities is more diversified which can support the development of synergies and innovation. On the demand side, citizens have higher wages and more sophisticated taste, and this creates “a high and differentiated level of consumer demand”. Cities also are turbulent places which needs “constantly redesign and rebuild urban order” (e.g. streets, water supply, sewage system, energy and transportation). In the other words, cities have to be innovative to solve problems related to sustainability of the city.

3.1 What is innovation?

In brief, innovation is focused on the research and development system and high-tech activities. The perspective of broad approach innovation is seen as everyday activities (such as procurement, production or marketing) of firms, organisations and sectors. (Johnson 2008.)

Innovation is something “new”. This ”new” can emerge because of individual flash of wit, because of identified urge or need or very slowly progressing towards solution of a problem. In many cases, all these elements are present, but their relative weight might differ. As goes without saying, definitions of what are in fact innovation takes multiple shapes and there is no generally accepted formulation; a few of these definitions, non-academic, are listed below (Merriam-Webster.com 2014):

1: the introduction of something new
2: a new idea, method, or device.

Definitions of innovation:

"The process of translating an idea or invention into a good or service that creates value or for which customers will pay. To be called an innovation, an idea must be replicable at an economical cost and must satisfy a specific need." (Business Dictionary 2014.)

"Innovation generally refers to changing or creating more effective processes, products and ideas, and can increase the likelihood of a business succeeding. Businesses that innovate create more efficient work processes and have better productivity and performance" (Government of Australia 2014).

"Innovation is a new idea, device or process. Innovation can be viewed as the application of better solutions that meet new requirements, inarticulated needs, or existing market needs. This is accomplished through more effective products, processes, services, technologies, or ideas that are readily available to markets, governments and society. The term innovation can be defined as something original and, as a consequence, new, that "breaks into" the market or society" (Maranville 1992).

The above examples show that satisfying a need in a novel manner is the key to the concept of innovation. However, one could equally well argue that the above definitions represent economic or utility-based definitions of innovation. When Einstein developed his theory of relativity, was there a particular need for it? Or when Eadweard Muybridge developed his Horse in Motion in 1878, was the market potential for motion picture already observable?

3.2 What is urban innovation?

Cities are described as "the cradles of creativity and innovation" (Johnson 2008). Physical place is still important although virtualisation is becoming more and more common. Innovative firms, organisations and people will cluster in specific places in the future. In order to develop urban areas, the investments in efficient infrastructure (e.g. transportation, water supply, sewage system, waste management) and polity (e.g. policy-making system, judiciary and administration) are needed. The "adequate social capital, forums of participation acceptance of responsibility and empowerment of citizens, networks for communication and capacity building

and room for subcultures and cultural diversity" are important in developing the urban area. (Johnson 2008.)

Although the cities are innovative places and most of the innovations are emerged in urban areas, all the innovations created in cities are not urban innovations. Urban innovation (or city innovations) is locally and widely adopted reform or improvement in urban environment that increases people's personal quality of life or sustainability of built environment. Innovation can be related to housing, transportation, supply of services or citizens' daily life and participation. Urban innovation can be for example new product or service, process, marketing method or organizational method in business practices. Urban innovations are rooted in practices with stakeholders (e.g. end-users, municipalities, citizens and firms). (Kaupunki-innovaatiot 2014.)

Valovirta et al. (2011) defines urban innovation as technology based services or organizational method or strategy that is designed for urban environment. Mostly, they are systematic. Typically, they consist of several "pieces of innovation", which can be involved in service process, products, technology, value chain or organizational methods. Urban innovations can categorised in three classes by the operator: a commercialised product or service by private sector, a service innovation by public sector or a mutual concept by public and private sector which produces new services. (Valovirta et al. 2011.) The urban innovations can also be distinguished in cultural or intellectual, technological-productive and technological-organisational urban innovations. (Hall 1999)

Leif Edvinsson adopts a term "knowledge city" and defines it as follows: "a city that was purposefully designed to encourage the nurturing of knowledge". The word "nurturing" is obviously the essence here. Cities are not smart or knowledgeable, only the people that inhabit it. The same applies to organisations. In plain words, cities, organisations and networks are only as smart or intelligent as the people who dwell and man these, and how smartly these people build networks and interaction between each other that allows good, value adding and beneficial things, processes and practices to take place.

In sum, the place (urban environment) and the purpose (to improve or make living easier) are the key elements in the definition of the urban innovation. Urban innovations do not emerge and evolve on their own. Thus, the stakeholders, such as citizens, communities and organisations and municipalities, are needed. Their thinking, actions and efforts may be innovative and create new innovations. Explicitly our sum-up emphasises the practical side of matters rather than high-level policies or strategies. Needles to underline, though, the high-level architectures and frameworks might equally well boost or balk innovation, depending on how cleverly they are designed and implemented.

3.3 Motivation behind urban innovation boosting

The ultimate motivation of any city is the concern over citizens' well-being. Citizens require services, such as health care, schools and urban infrastructures, and

for these services there needs to be a sufficient commercial and industrial base, i.e. firms offering jobs to citizens. The local economy is first and foremost dependent on employment facilitating adequate public services. The cities have realised that their success is almost entirely dependent on the success of the firms operating within the city limits or at least within vicinity, and on other institutions creating gravity that provides income to citizens and further to the city to provide services.

Recent decades' globalisation have shifted the focus from national competition (cities competing with each other) to international. To gain sufficient positive inertia in local economy, cities need not only small and medium sized companies that succeed in domestic markets but they also need forerunning international firms that compete and succeed globally. Facing these challenges, the cities have become a part of global economy and rivalry. Successful, high-income citizens are drawn to places where successful companies and organisations are, and where standard of living satisfies them.

Figure 2. Cities are the focal spots of human activities (by the permission of City of Oulu).

Hence cities are forced, and in most cases not at all unwillingly, to facilitate concentration of significant economic activity, that in turn calls for innovations to take place. Cities have become innovation hubs and it a recognisable trend how cities' strategies and planning has changed from "authorial, centralised planning" into "innovation and knowledge facilitation".

As each city is different, their strategies for innovation boosting differ accordingly as do their segments of emphasis. Cities with significant industrial clusters profile themselves quite accordingly: Detroit and Gothenburg are "the motor cities", London and Frankfurt are centres for financial industry, San Diego and Oulu have been in the heart of intelligent and innovative high-tech clusters, etc. The more cities can profile themselves as "centres of something", the more likely they are lure investments, facilities, and talent. However wherein profiling itself as a "motor-city" and "financial centre" is nowadays extremely difficult, due to the market re-

structuring and long history, being intelligent and innovative has become a trend and a way to lure multi-disciplinary and diversified investments.

The term of intelligence refers mostly to the technological innovations while the term of smart refers to more user-friendly approach in marketing. Smartness in technology means automatic features such as self-healing, self-configuration, self-protection and self-optimisation. (Nam & Pardo 2011.) Nam and Pardo (2011) and Schaffers et al. (2012) have listed definitions for smart city. They underline integration (e.g. integration of technologies and conditions), and the forward-looking and superior deeds. Things are done somehow better: more efficiently, more sustainable, more intelligently, with higher quality of life or better optimised. Smart cities are innovation drivers in the fields of health, environment, economy, living, people, governance and education. (Nam & Pardo 2011, Schaffers et al. 2012) According to the case studies of Schaffers et al. (2012) smart city is a target stage in the future. Many actors such as organisations, communities, research and development, non-governmental organisations (NGOs), clusters and authorities are involved in building the smart city, and they try to achieve “a common vision, flag ship projects, collaboration and synergy”. The major challenges which a smart city are facing are “skills, creativities, user-driven innovation, entrepreneurship, venture capital funding, and management of intra-government rivalries” and how to deal with them. (Schaffers et al. 2012.)

How to develop the cities into the engines of innovations? According to Schaffers et al. (2012), the following ingredients are needed to build smart city: local government, citizens and businesses, user-driven innovation environments and research and technology communities. The function of local government is to develop and implement policies for urban development (e.g. decision making process). Citizens and businesses are organising themselves to interest groups and/or professional communities. User-driven environment brings together different actors in a relevant value network. Research and technology communities provide technological know-how and facilities to test and evaluate the technology. (Schaffers et al. 2012.) Dvir & Pasher (2004) have listed some elements which enable the emerging of innovations. For example organisation structure should be flat and low hierarchy and structure should have weak boundaries of departments. Additionally, the atmosphere should encourage to creativity, out-of-box-thinking and risk-taking and the failures are not punished. Cities have to communicate with their stakeholders and involve their “talent, insights and perspectives” into process. Innovation engines (or innovation centres) must not become “isolated ivory towers”. They must communicate with each other and “city’s flows” (or city processes). (Dvir & Pasher 2004.)

4. Generic innovation process models and urban development

4.1 Models of innovation processes

Likewise with concept “innovation” there is no single “innovation process” definition or model. The innovation process, i.e. the flow of actions or measures towards final innovation can be associated with single product, a particular process (manufacturing, service, etc.) or it can be understood as the interaction within multiple stakeholder networks that generates new ideas.

As much as innovation management has gained attention in recent years, the topic is well-covered in thousands of references. As early as 1967, Knight (1967) recognised different types of innovations (product or service, production process, organisational, and people-type). His innovation process was simplified to three steps 1) recognition of the problem, 2) search process, 3) solution (innovation). Since then, numerous refinements have been done in an attempt to capture finesses of the innovation process.

One good summary is found from Rothwell (1994), as he presents the five very commonly referred innovation process models:

- The 1st generation technology -push model according to principle “more R&D will yield to more successful products”.
- The 2nd generation model adopted a linear sequential relationship between science and functional industrial process (design & engineering, manufacturing, marketing, sales) and was by and large just an extension of the 1st generation model.
- The 3rd generation model was relying more on market needs that was the guiding star for development of new products and services – the so called “market pull” model. This model already adopted a view where market needs were in constant dynamic interaction with all the functions of the firm. Especially the relationship between new market needs and new technologies was recognised.
- The 4th generation model applied an even more integrated philosophy. New products were developed not only technology push and market pull in

mind, but also acknowledging that the available resources and capabilities needed to be taken into account. This extended the 3rd generation model so that company's production, sales and supply chain constraints were more tightly integrated in the innovation process. Furthermore, the upstream feedback from distributors and customers were more carefully considered. Japanese automotive manufacturers are recognised pioneers of this model.

- The 5th generation model extends the previous innovation process model in the understanding that innovation process was starting to resemble a dynamic network where value chains and external factors, such as technological change, were in constant interaction with different stages of the innovation process and different functions of the organisation. Cross-disciplinarily, ICT-enabled virtual teams, flexibility in both operations and products, customization, variant enabling, and parallel multiple processes characterise this innovation process model.

Not only has the innovation process transformed in time, but also the networks in which innovation takes place. This is also observable from the previously shown process model evolution. Loose networks, consortia, alliances, clusters and dedicated supply chains are examples of such networks. Tidd et al. (2005) distinguished four major types of innovation networks: 1) sector *fora* and supply chains, 2) alliances and consortia, 3) multi-company networks around complex product/service systems, 4) "best practice" clubs or regional networks.

Of course, all the process and network models are typifications that must be applied to real-world contexts understanding that the empirical real-world examples could be combinations of several models and not necessarily following precisely the academic categorisation.

4.2 Urban development process and innovation process

Urban development, at least as far as physical infrastructures and urban spaces are concerned, follow a rather common planning philosophy or system that by and large repeats in industrialised countries. However, in details the planning systems could deviate from each other quite substantially. Our domestic planning system comprises the following parts:

- national land use guidelines set by the ministries and central agencies
- regional land use planning (covering multiple municipalities and cities) exercised by regional governments and agencies
- local master planning to direct detailed plans carried out by municipalities and cities
- local detailed plans (municipalities and cities).

The most prospective innovation potential lies in the phase where local detailed plans are derived. Practical novel solutions, new technologies and applications take their place most naturally in this phase as well as have their most practical form. Examples of novelties that could be involved are:

- new technologies for housing, infrastructures and built environment in general, such as new street lighting systems, sensors to monitor built environment subsystems (e.g. waste management systems), new energy technologies, etc.

The other prospective phase is the preceding planning stage, where local master plans are drafted. Here the innovations also start to take more systemic nature, as many details may be yet open but the overall built environment system starts to take shape. New systemic solutions or technologies could include, for example:

- new waste management systems for wider area, de-centralised and localised energy supply systems, new types of housing formats, etc.

All the above examples require the engagement of private sector actors, be they developers, tech-solution providers or contractors and equally the public-sector led planning process must take these actors into account if their capacities and innovation power is wished to be utilised.

For the earlier planning phases it is more difficult to see actual innovation potential, although some private sector stakeholders certainly have interests regarding these phases too. For instance, power supply companies are certainly keen to know where major supply lines and facilities are planned to be located as these decisions have quite explicit impact on their investment decisions. It is not, however, said that the earlier regional planning phases lack innovation potential, but positioning of a facility or major infrastructure may not in the end contain interesting innovation elements as prospectively as the latter phases do.

5. Underlying innovation programmes and processes

5.1 RESCA programme

The objective of the Finnish government is to raise the share of the renewable energy into 38 per cent by the year 2020. This objective also has an impact on the climate strategies of municipalities/cities by setting challenges for them. The cities and urban areas differ from each other but many connecting factors have also been found. These connecting factors are tried to exploit in order to answer climate challenges.

Renewable Energy Solutions in City Areas (RESCA) is a joint-programme of the largest towns in Finland co-ordinated by Hermia Group. Originally RESCA started on the initiative of city of Tampere and its background lied in TreSolar solar energy study made by ECO2. Afterwards the Finnish cities of Tampere, Turku, Oulu, Vantaa and Helsinki Environmental Services Authority (HSY) also joined to the programme.

Within the programme, the partners collaborate in increasing the utilization and exploitation of renewable energy and its solutions. The objective of the programme is to create a common operating model and to exchange the best practices of the pilot projects with other cities.

RESCA cooperates with the Finnish energy and construction companies and public companies. In some cases, Finnish companies can utilize the pilots as their own export references. RESCA increases the production of renewable energy and develops models of operation by passing on information and best practices between cities. The pilots are related to several technologies and solutions (Hermia Group 2013):

- Hybrid and carbon-neutral solutions of renewable energy
- Bioenergy
- Identification of impacts on the environment in town planning and land use
- Aqua thermal solutions
- Solar technologies

- Wind power
- Biogas as vehicle fuel

Through collaboration, the utilization of renewable and sustainable energy can be increased and the best practices can be shared among partners and other interest parties.

One of the main objectives of RESCA is to find out how the partner cities can create better prerequisites for the adoption of renewable energy and its solutions. Key factors in making new energy solutions more common in urban areas are the creation and distribution of proven operating and service models and management of the entire energy system and all facets of infrastructure.

The collaboration in a program is focusing on the planning of pilot projects for renewable energy but also the dissemination of gained information. As far as the pilots are concerned, good practices will be submitted to all parties. The objective is to have approximately 12 interesting pilots (technology applications and operating models). The pilot project should offer novelty value for the target cities. In addition, the best pilots also replicated in several cities and by that several different operating models and technology measures can be got. Afterwards the adoption of renewable energy can be promoted.

The programme also serves the promotion of exports indirectly in it can bring in Finnish businesses to the industry to implement the projects. In the best case scenario, the companies will be able to utilize the targets as their own export references. RESCA will promote both the attainment of the cities' climate objectives and the development and business operations of the business world from a company perspective. (Hermia Group 2013, City of Oulu 2014.)

5.2 Innovative Cities programme

Innovative Cities (INKA) programme aims to generate new business and new companies from high-quality competence and hence creating more jobs as well. The programme is underpinned by close local collaboration and pooling of resources between science, research, education, companies and the government. The methods used will contain the development of new environments, creation of pioneering markets, and national and international collaboration in leveraging expertise.

Development environments can contain demonstration and testing of platforms for new technologies and services and new operating models for competence-based entrepreneurship. Major investments for the future made by the cities, for example in energy and water supply, waste management, housing, transport and health care, have as yet not been exploited as development platforms for innovations. Development and piloting will be carried out in authentic development environments in cooperation between users, companies and the public sector. In order to create a pioneering market, the cities and partners are also expected to use

innovative procurements (e.g., project alliance) more often. The objective of these measures is to increase the exports of companies.

Demand-driven, solution-centered and multi-sectoral themes that combine several competence areas were selected for the programme from among proposals submitted by the urban regions. This procedure is different from the traditional technology or sector oriented approach. The themes draw extensively on both Finnish and international expertise.

The Ministry of Employment and the Economy (TEM) has approved five national themes for the programme and named the urban regions responsible for leading the work on them. Seven other urban regions have been approved as partners.

- Bioeconomy (theme): Joensuu, Jyväskylä and Seinäjoki (partners)
- Sustainable energy solutions: Vaasa, Lappeenranta and Pori
- Future health care: Oulu, Kuopio, Helsinki Metropolitan area, Tampere and Turku
- Smart cities and industrial regeneration: Tampere, Lahti, Oulu, Helsinki Metropolitan area and Turku
- Cyber security: Jyväskylä

The funding of the INKA programme is about 20 million euros annually. The 10 million is contributed by the Finnish government and the other 10 million by the urban regions annually. Additionally, EU Structural Funds financing will be earmarked for the implementation of the programme. A review of the programme themes and urban sub-regions will be held in 2017.

Tekes – the Finnish Funding Agency for Innovation is responsible for the operative management and administration of the programme. Strategic steering and programme evaluation will be the task of a steering group comprising representatives from the Ministry of Employment and the Economy, the Ministry of Social Affairs and Health, the Ministry of Justice, the Ministry of Transport and Communications, the Ministry of the Environment, as well as The Finnish Innovation Fund (Sitra) and Tekes.

5.3 The visions and strategies of city of Oulu

Oulu is the sixth largest city in Finland, the largest city in northern Finland and the largest urban centre in northern Scandinavia with over 200,000 inhabitants, including 5000 foreigners representing 116 different nationalities. In addition, Oulu is the fastest growing region in Finland. Hence, the city of Oulu can be regarded as the capital of northern Finland or the capital of Northern Scandinavia.

The city's residents are its most important asset. The drive towards the future and to create and innovate is likely due to the region having the youngest population in Finland and in Europe with an average age of 34.5 years. There are good opportunities for studying, working and research and development, especially in the hi-tech sector. The Oulu Region also has a lively cultural climate.

In recent years, Oulu has invested lot in the development of the city and hence they have created ambiguous strategies and visions for city. The visions and strategies of Oulu can generally be summarized in four words: arctic, sustainability, renewable and smart.

5.3.1 Smart-city approach in Oulu

Oulu has the largest regional research and development (R&D) spending per capita in Finland and the 5th largest R&D spending in Europe. The city of Oulu is well-known for its information and communication technologies (ICT) sector which employes approximately 14 000 people in the whole region. Oulu has also invested in and hence created a good business infrastructure and innovation and R&D friendly central administration. (Rantakokko 2012.)

The city of Oulu has got many acknowledgements as a proof of global level of "smartness and innovativeness", For example, Oulu was mentioned in Fortune magazine list of the seven best new global cities for start-ups. In 2012 Oulu was awarded for being the most intelligent community in Europe, and was also ranked to the Top7 globally in 2012 and 2013. Basically, the City of Oulu is a great example of a smart-city because the smart approach has been successfully implemented in business and innovation development. Actually, the city can be regarded as one of the pioneer of smart cities and Oulu has driven the smart city ideas already from the early 90's.

Oulu's smart-city "strategy" is mainly based on the long tradition of collaboration between education and research institutes, companies, public sector and innovative individuals. In other words, being smart city is about the Public-Private-Partnership. Smart city Oulu approach to collaboration activities is strategy driven and innovation oriented; its collaboration projects are developed and executed based on the real need which means that focus is on the fast and easy implementation and deployment of the gained results. (Rantakokko 2012.)

5.3.2 Winter and sustainability as a strategy and focus area in Oulu

The visions and strategies of the city of Oulu have mostly focused on the themes of winter and sustainability. In particular, the supervision of building has emphasized the importance of sustainability and new innovations and hence they strongly support the usage of new and sustainable solutions in construction.

Therefore, the city of Oulu started few years ago a new development initiative that is part of RESCA and INKA–programs. The main objective of the initiative is to develop more effective methods and processes that enable new and sustainable solutions to be taken better into account in construction and supervision on it. In addition, the second objective is to provide pilot areas for companies so that they would be able to develop and test "the solutions of tomorrow". Hence, the program supports companies' product development but it also reduces their risk of failure.

Figure 3. Winter biking in Oulu (by the permission of City of Oulu).

Once again, winter and the arctic climate are the especial focus areas. One purpose of the development initiative is to gain experiences, test and find solutions that are the most usable in a house building in arctic areas, such as Oulu. In addition, the companies develop their business have competence that may create competitive advantage through the program. At the moment, both development activities and visions of the city of Oulu have concentrated in one area, Hiukkavaara centre, For example, Oulu's RESCA-area locates in Hiukkavaara.

Figure 4. RESCA area in the outskirts of Oulu – partly built (with permission of City of Oulu).

The area of Hiukkavaara has been selected as a development environment and pilot area (referred as a Living Lab and/or Arctic smart city) for the sustainable winter city theme. More particularly, living labs act as generators of ideas and innovative solutions through the open innovation, and collaboration of companies and actors from both the demand and supply side in the relevant value networks and ecosystems. It is a fundamental trend of smart cities that solutions have to be defined and implemented with the involvement of citizens, as consumers and end-

users, as well as large enterprises and SMEs both acting as advanced users and suppliers, together with researchers and policy makers. (Rantakokko 2012; Schaffers et al. 2012.)

Experiences and lessons learned gained from the living labs can be used and exploited afterwards in development and planning of the other areas of Oulu. Hiukkavaara is the largest city district to be built in Oulu and the whole of northern Finland in recent decades. Homes for 20,000 new residents will be constructed around the old military barracks area. In addition, the Hiukkavaara centre will serve 40,000 residents from the surrounding areas.

As a strategy and theme, winter strongly steers the development, planning and building of Hiukkavaara centre. The winter city strategy has five major focus areas that together form harmonious entity:

- Communication – the story of winter
- People – Living in northern winter city
- Taking winter into account in planning, use and maintenance
- Winter events and experiences – development of tourism
- Winter as a business – ”snow-how”, pilots, development and new competences

Hiukkavaara can be regarded as a user-oriented. It takes into account its residents and companies, has collaboration with them and serves them. This “low threshold” city gives its residents space to express themselves and creates opportunities for recreational activities and enjoying the northern nature. Hiukkavaara’s apartments, buildings, district, yards, streets and parks are all designed by considering people and residents as well as possible. In Hiukkavaara, you can walk, cycle and ski: nature starts at your front door, yet the shops and cultural events are within walking distance. Furthermore, Hiukkavaara is an international digital service home, where information and communications technology companies take part in developing the intelligent future of living and recreational activities.

Hiukkavaara is a development environment for living and services. It provides premises for research, development, testing and launching. How can a home become energy efficient, how are renewable energy sources utilised and what kind of new services are needed in the future? Hiukkavaara is an Arctic Smart City where researchers, aiming for state-of-the-art expertise, come face-to-face with the practical use of applications, and where companies developing services can get inspiration from the outcomes of everyday life.

Hiukkavaara is a model for climate-conscious design in the northern hemisphere. Energy and materials are conserved, nature is valued and human beings adapt to their environment. Winter is the starting point for community design in Hiukkavaara. The architecture of a snowy city, the sunshine of a crisp winter day and the joys of winter time sports provide new opportunities for designing a city district. The areas used for storing snow (from the removal operations) in the winter are used for floorball and basketball games in the summer. The city district will be planned taking the weather into account: if the weather is good, people can

enjoy the fresh air, but if it is bad, they can choose an undercover route that protects them from the rain.

6. Core processes

6.1 The trajectory of the Oulu Building Supervision Office

The participation of the city of Oulu in RESCA project is not a consequence but a natural part of the long trajectory which starting point is in the late 1990s. At the time many buildings, including old and new ones, suffered from moisture related problems. Due to that Oulu Building Supervision Office (or to be precise, in the beginning a handful of individuals) pondered how they could most effectively help builders and developers. Because the Office cannot require more than the National Building Code of Finland instruct (i.e. the minimum level of quality), the only way to improve the technical quality of buildings was to "hook" the private developers of one-family houses to start requiring the better and more durable solutions from the builders. Together with University of Oulu, Oulu University Applied Sciences and VTT Technical Research Centre of Finland, Building Supervision Office started to organize training and guidance courses for the house builders to improve their know-how, awareness and capability to require better solutions. In addition to training, illustrative on-site measurements were organized to point-out the problems in a real-life context.

If the operation in the early 2000s were more or less dependent on some individuals, it became more concrete and systematic in 2005, when the annual housing fairs was in Oulu. One of the themes was the technical quality of one-family houses and how to improve that. Therefore, the Building Supervision Office started to develop their processes towards more systematic and holistic, which finally occurred in the service called "pientalonlaatu.fi" targeted for private citizens building their own houses or having them privately built. It is website based service where the builders and developer can compare (each solution have their own rate) different technical solutions against each other. In 2005, the service include there different technical areas: energy consumption, resistance against moisture and environmental impacts. It is worth mentioning that all the houses in the housing fairs were rated by using the service in order illustrate the effect and impact of the different solutions to the visitors. In 2007, "pientalonlaatu" was expanded to cover the quality of habitation (including e.g. homeliness, usability, and functionality).

Finland, along with other EU-countries, has committed to EU- directive in lowering emissions, and thus in 2010 Finland's Construction regulations were tightened,

which demands, for example, to reduce the energy consumption of buildings and increase the energy efficiency. In practice this meant that the new buildings consume more renewable energy, insulations get tighter and the air-tightness is better. However, ever tightening regulations caused moisture related problems again and that is why in 2013, Oulu participated in the Nordic project called IEEB (Increasing Energy Efficiency of Buildings) which aimed to create a network of the Nordic academia, research, industry and society for developing new solution and innovations promoting energy efficiency in buildings. In addition, the purpose was to find new ways to plan and build health more energy efficient buildings but also proactively contribute to sustainable development of the environment and community.

The IEEB project developed new competencies and expertise especially in measurements and methods for advanced design of energy efficient buildings, picks up and documents the best practices and recommendations based on real-life information. Ultimately all the accumulated knowledge were disseminated and shared to building experts and industry representatives, both local and regional authorities, and citizens, educators, equipment manufacturers and system providers. In Oulu, the IEEB project focused on measurement, analysis and monitoring the impact of different solutions on temperature, moisture and pressure. The data was collected by the sensors placed inside the structures (e.g., walls, roofs, floors). The monitoring is still ongoing and it is utilized in the current projects.

Oulu's open-minded and proactive development activities were noted in Finland and in 2012 the hard work was acknowledged. The Oulu Building Supervision Office was awarded for their enthusiastic work for the quality issues by the Finnish Association of Architects (SAFA).

The energy regulations were tightened in 2012 again; for example, in 2020, 38% percent of consumed energy must be originated from the renewable sources and the CO_2 emission must be 16% lower than in 2005. Because the city of Oulu still had a desire to improve the quality of housing and living, Oulu made a decision to participate in RESCA –program. The new regulations also instruct that so-called E-number must be calculated to every new building. E-number (kWh/m^3) is linked energy efficiency and consumption of the building and smaller the number the better. As it can be expected, the sustainable development and renewable energy solutions are favoured. At the moment, the calculations of e-number are solely theoretical and therefore one of the RESCA's purposes was to gain real data from the houses and increase the understanding about the sources of renewable energy and sustainable solutions.

Although RESCA was finished 2014, the Oulu Building Supervision Office continues their development activities by launching a follow-up project called *Future buildings and renewable energy*. It exploits and further develops the experiences and results gained from RESCA project. As the solutions made in RESCA area are novel, and no experience of the behaviour of the technologies and their combinations have not been obtained, the project Future buildings and renewable energy was seen as a natural continuum to the RESCA project.

The overall aim of the project is to optimize energy technologies or their combinations and energy efficiency together economically and technically in order to produce a functioning solution. Like in RESCA project, the best practices will be copied and disseminated to both construction enterprises and consumers. Energy solutions are intended to be measured, developed and analysed in order to develop technologies and solutions.

In addition, the city of Oulu is committed to ERA17 (energy-smart built environment 2017) action plan, which refers to an energy-efficient, low-emission, high quality built environment that employs all necessary means to mitigate climate change. There are many factors that contribute to energy-smartness: land use, construction and renovation, ownership and use of real estate, as well as utilisation of renewable energy. The plan's ambitious goal is to reach the efficiency requirements set for 2020 three years early, in 2017, in Finland's centennial year. The ultimate goal of the plan is that in 2050, Finland will be able to offer the world's best living and operating environment for people and businesses.

Figure 5 summarizes the long trajectory of the Oulu Building Supervision Office.

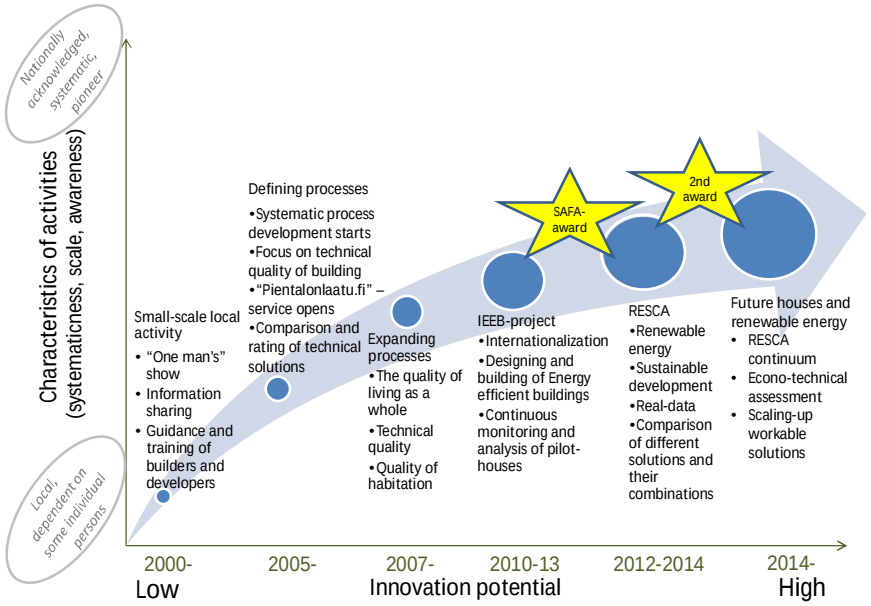

Figure 5. The path of the Oulu Building Supervision Office.

6.2 RESCA project of Oulu

6.2.1 Motivation and objectives

The energy sources or their combinations as well as the energy-efficiency properties of new buildings will be optimised into functional entities. In Oulu the goal of RESCA is to create concepts for choosing different kinds of renewable forms of energy for single-family homes and concepts to optimize the combinations of different forms of energies (hybrids). Also the energy efficient solutions of building to enable the use of renewable energies are being developed. The goal is to use the developed concepts to guide new single-family home builders to using more renewable energies by making choosing them easy. Final goal is to create well proven and working solutions of hybrids.

To reach the objectives of RESCA in Oulu, the Oulu Building Supervision Office has started and is supporting the building of circa 45 single-family homes in the newly zoned area of Hiukkavaara. 18 companies are participating in RESCA and they are building energy efficient homes with different kinds of combinations of renewable energies to the area. The goals of RESCA in Oulu are the following:

- To produce reasoned and safe concepts to guide and help builders and planners in choosing and combining renewable energies for single-family homes.
- Concepts must be simple to use, effective and they need to be applicable to be used in building supervision office's quality guidance.
- Concepts need to be applicable in other cities and they need to further fulfilling the international obligations Finland has.

In general, Hiukkavaara act as "a Living Lab", where the city of Oulu offer possibilities and plots for constructions and design companies to perform pilot projects. By doing so, the firms but also the city of Oulu gain new experiences and knowledge about the solutions, which is essential because regulations have changed a lot in recent years and the projects are more or less prototypes for the builders and designers. Furthermore, using Hiukkavaara as a Living Lab, the city of Oulu can use the same area for the forthcoming development projects. Figure 6 illustrates the main steps of RESCA program from the perspective of the city of Oulu.

As stated earlier, the starting point for the participation in RESCA program where the ever changing energy regulations that in some extent forces professional builders and construction firms to implement and commercialize solutions that have not been properly tested earlier. Therefore the city of Oulu decided to support firms by offering a possibility to build pilot houses in the RESCA area at Hiukkavaara. By collaborating with firms and forthcoming habitants, the city of Oulu gain experiences from the different solutions and projects and hence can develop their own process as well. At the same time, being part of the pioneering activities, the city can prevent the spread of bad and problematic solutions. In

larger, RESCA program was part of the TEKES funded program *Sustainable Community.*

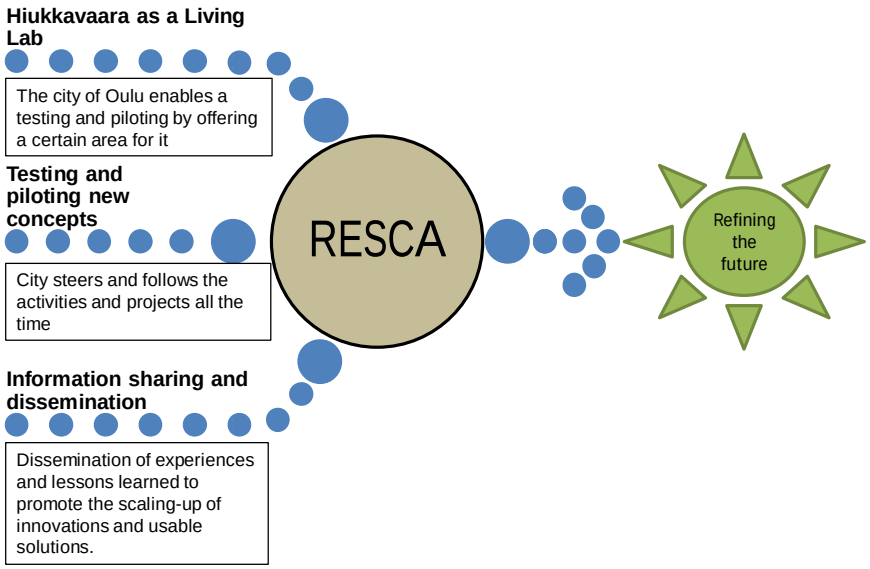

Figure 6. RESCA in a nutshell.

6.2.2 Chronology of Oulu's RESCA and outcomes by autumn 2014

Oulu's RESCA project can be considered successful. The latest news from the field, Oulu's RESCA project will be awarded later in this year for its success. Once again, it is a clear sign of pioneering and systematic action that has been done in Oulu by the Oulu Building Supervision Office. Figure 8 illustrates the chronology of RESCA project of Oulu more in detail.

When it comes to the concrete results of RESCA, 80% of the RESCA area is under construction by October 2014 and the first houses are already completed. It is presumable that the most of the buildings can be completed by the end of 2014. The buildings constructed by Oulu Vocational College and Oulu University of Applied Sciences will be ready a bit later, because those certain buildings are used also for the training and education of students. Such approach supports the development of local competence but also long-term plan of the city of Oulu and its Building Supervision Office.

There are plenty of other concrete results that are connected to RESCA project. Probably the most noteworthy investment is 400 MWH Combined heat and power (CHP) plant, which will be completed in the summer 2015. The produced heat will be used completely in a terraced house (32 apartments). Power plant will also

produce some excess electricity (40 MWh) that will be sold to the local energy company.

Figure 7. RESCA pilot area in the Spring of 2014 (photos: Pekka Seppälä, Aki Töyräs, permission granted).

The measurements and assessments clearly point out that the completed houses and buildings are very energy efficient and they utilize renewable energy in very innovate manners. For example, the E-number of one completed house (157 m^2) is small as 35 (kWh/m^3) while in the "traditional version" of that same house, the E-number can be as high as 173. To get E-number so low, the pilot house utilizes the geothermal, heat pumps and solar energy, and the energy consumption of the house can be monitored in real-time as well. In addition, there are some very innovative and new methods that are going to be used, such as exploiting heat of the waste water and the fully automatic control systems.

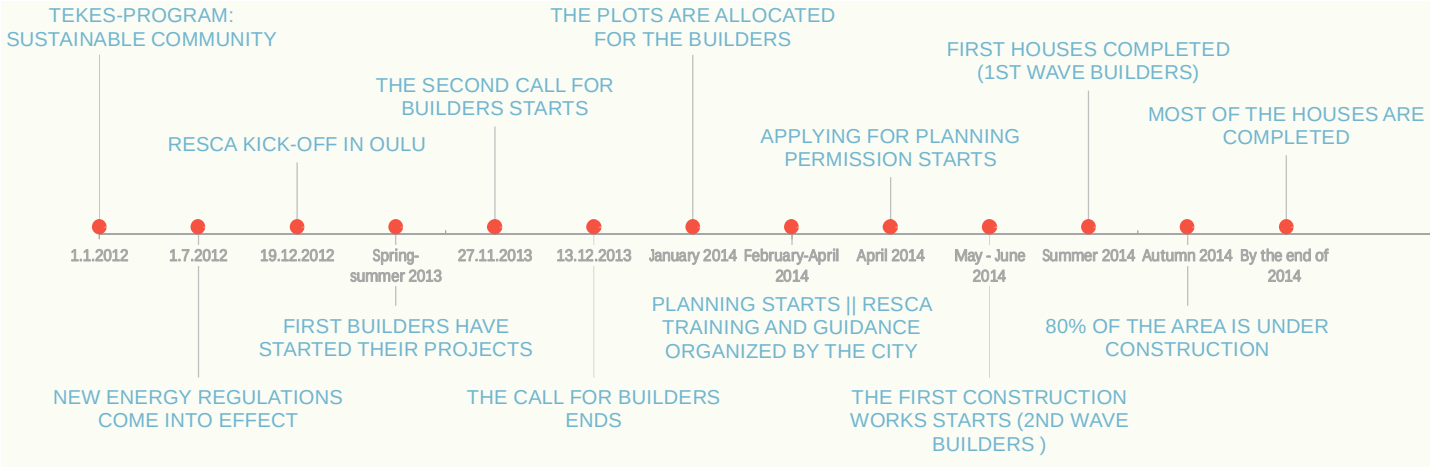

Figure 8. The chronology of RESCA in Oulu.

6.3 The standard process of new housing area development vs. RESCA

Oulu's burning desire to be a pioneer and their commitment to ERA17 action plan has a clear impact on their all activities and hence on the RESCA project as well. Based on their objectives, they have set some constraints and terms for the buildings in the RESCA area. These constraints and terms are in line with Oulu's objectives but a relative unusual in the rest of the Finland. In addition, the set constrains separates processes of standard new housing area and RESCA area from each other. The constraints and terms for the houses in RESCA area are, for instance, as follows:

- The plots are only for (development-oriented) firms or educational institutes.
- Energy consumption must be equal or lower than 70% of the set level in the law.
- Houses must utilize "hybrid" energy solutions (i.e., combinations of solar, bio, wind, geothermal, heat pump, wood energy systems).
- Buildings met nearly zero-energy level.
- Buildings must be sustainable in terms of ecology, economy and society.
- Innovative solutions are prioritized.
- The city of Oulu supports the scaling up of workable and reliable solutions.
- The city of Oulu demands measurements, analysis and monitoring of the pilot houses (temperature, pressure, moisture, heat loss etc.).
- If solar energy is used or there is a readiness to use it later, the positioning of house must be taken into account in order to optimize the efficiency of solar system.
- The gained experienced and results can be, and will be, exploited afterwards.

The aforementioned terms points out clearly that the city of Oulu has content their self with the minimum level of quality which is set in the National Building Code of Finland. Instead of that, Oulu wants to improve the quality of living of habitants by offering both guidance and possibilities to be a forerunner.

7. Results and discussion

7.1 Positioning of RESCA in innovation typologies

Inter-firm collaboration has always been natural part of the evolvement and diffusion of innovations. Companies collaborate in various ways which have an impact on the type of innovation; usually the simplest forms of collaborations focus more or less on incremental innovations and development activities while the most complex collaboration models strive to produce radical and spearhead innovations. Simultaneously when the collaboration gets deeper and the complexity of the collaboration network increases as well. Hence it is typical that the radical innovations are mostly invented in very heterogeneous networks. The typical stakeholders that collaboration may include are customers, suppliers and other partners, competitors, and different institutions, including universities (Belderbos et al., 2004; Un et al., 2010).

In their research, Majava et al. (2013) listed six different collaboration concepts where new innovations may arise. The listed concepts are: innovation hub, business cluster, business network, business ecosystem, triple helix and keiretsu. In this research, Keiretsu is excluded because it occurs almost exclusively in Japan.

Zone 1: Innovation hub

Innovation hub thinking is based on the recent changes and trends in the business environments where companies operate. Instead of dominance by a single company, systems consisting of a nodal network (regional) of firms, individual consumers, and consumer communities work together to create value (Prahalad and Ramaswamy, 2004). Knowledge is distributed among many players, and companies are encouraged to take advantage of the available information, use others' ideas, and even allow others to use theirs (Chesbrough, 2003). Local uncoordinated innovation activities, regional programs, and technology parks have claimed to be evolving towards global innovation hubs (Launonen and Viitanen, 2011).

The creation of an innovation hub can be accelerated by different types of programs, organizational forms, and boundary-spanning roles among educational, private, and public domains.

Zone 2: Business cluster

Clusters can be viewed as geographical concentrations of interconnected firms and institutions in a certain field, and the idea of clusters suggests that regions should identify and develop their existing regional competitive advantage (Porter, 1998; Porter, 2000). A business cluster, also known as an industry or competitive cluster, can enhance regional economic growth and income, increase company productivity, drive innovation, and stimulate new businesses (Barkley and Henry, 1997; Porter, 1990).

Clusters may extend downstream to customers and channels, and laterally to producers of complementarities. Linkages and complementarities across industries and institutions most relevant to the competition define cluster boundaries; geographical location is still important, but its value is decreasing (Porter, 1998).

Zone 3: Business ecosystems

The logic in ecosystem thinking is that companies must proactively develop mutually beneficial relationships with customers, suppliers, and competitors (Iansiti and Levien, 2004). A business ecosystem is "an economic community supported by a foundation of interacting organizations and individuals—the organisms of the business world" (Moore, 1996). The economic community produces goods and services for the ecosystem members (customers). Other organisms include the suppliers, lead producers, competitors, and stakeholders. The companies coevolve capabilities around a new innovation: they cooperate and compete to support new products, satisfy customer needs, and finally build succeeding innovations. Other players adjust to the rules set by the lead players. The leaders can change, but the community values the role of the leader, which enables the members to move toward a shared future and benefits (Moore, 1996). A business ecosystem should be self-sustaining and develop through self-organization, emergence and coevolution, which results in adaptability (Iansiti and Levien, 2004; Peltoniemi and Vuori, 2004).

Zone 4: Business network or Triple Helix

Networks can also be considered as consisting of actors that control resources and perform activities: a company is dependent on resources controlled by others, and access to resources is achieved by forming relationships with other actors, creating interdependency between the actors and their relationships in the network (Håkansson and Snehota, 1989). Business networks are "structures of inter-firm relationships that emerge and evolve through continuous interactive processes" (Halinen and Törnroos, 1998). In recent years, business networks have expanded due to industrial restructurings, vertical disaggregation, outsourcing, and a strategic drive to focus on core competencies (Batt and Purchase, 2004).

Triple Helix is much like a business network, but in triple helix the collaboration is driven and steered by the government and the network always includes, in addition to government, participants from educational institutes and industrial sectors. Resulting from the governmental steering and education-industry collaboration, triple helixes are strongly connected to and influenced by the national innovation systems. Most countries and regions are striving to boost innovations through university spin-offs, initiatives for knowledge-based economic development and long-term collaboration between companies, government laboratories, and academic research groups.

In general level, the only difference of business network and triple helix is the involvement of government and educational institutes in triple helix. Therefore, triple helix and business network are combined in this research. Figure 9 illustrated the differences of the collaboration concept in relation to the type of innovation and the organizations in a network.

7.2 RESCA in innovation typology context

Based on the previous definitions of collaboration concepts, RESCA programme contains features from both innovation hub, and business network and triple helix (Figure 9). The reasons are following:

- Radical innovations are not expected but the purpose is to create useful and easily spread solutions.
- RESCA programme is put in practice by companies, but steered by the public authorities (heterogeneous). In addition, research organizations are vital part of the programme.
- RESCA participants has the mutual objective (in general).
- RESCA has integrated coordination but the rules are set by the public authorities.
- Innovations are mainly company specific.
- Relationships are formed to achieved objectives and create value, but the primary purpose is not to create global competitiveness.
- RESCA has public funding.
- RESCA is more or less focus local and regional development activities.

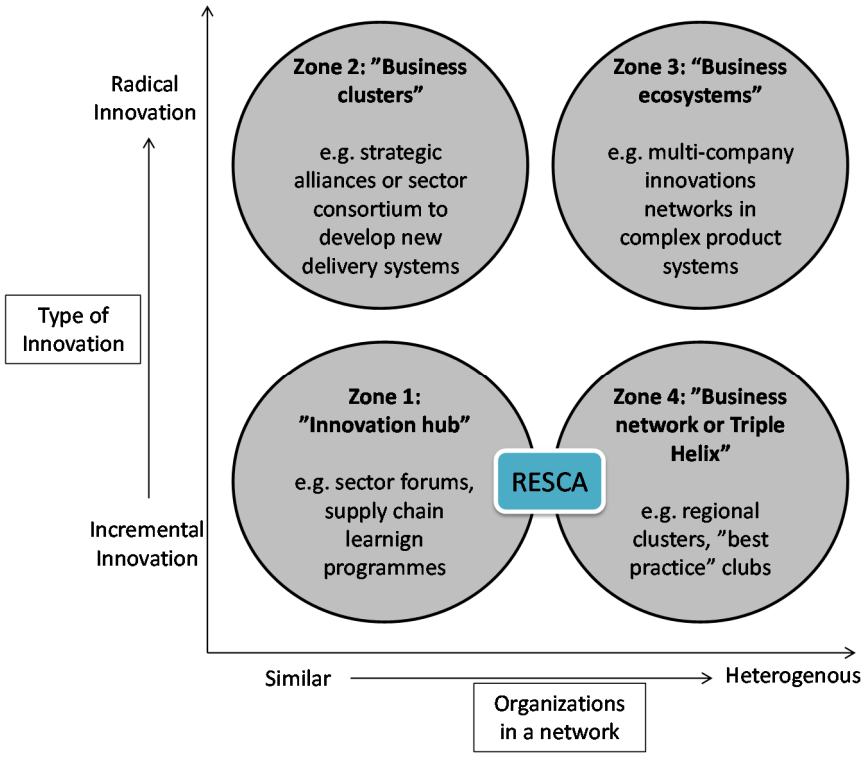

Figure 9. Position of RESCA among collaboration concepts (modified from Tidd et al. 2005).

As far as innovation process models (reviewed in Chapter 4) are concerned, RESCA seems to fit best somewhere in between 3rd and 4th level of innovation models. The method of working aimed more at incremental and scalable innovations than at radical innovations. The effort was shared between companies and administration, and furthermore, some of the companies were rather different from each other – hence the positioning as shown in Figure 10.

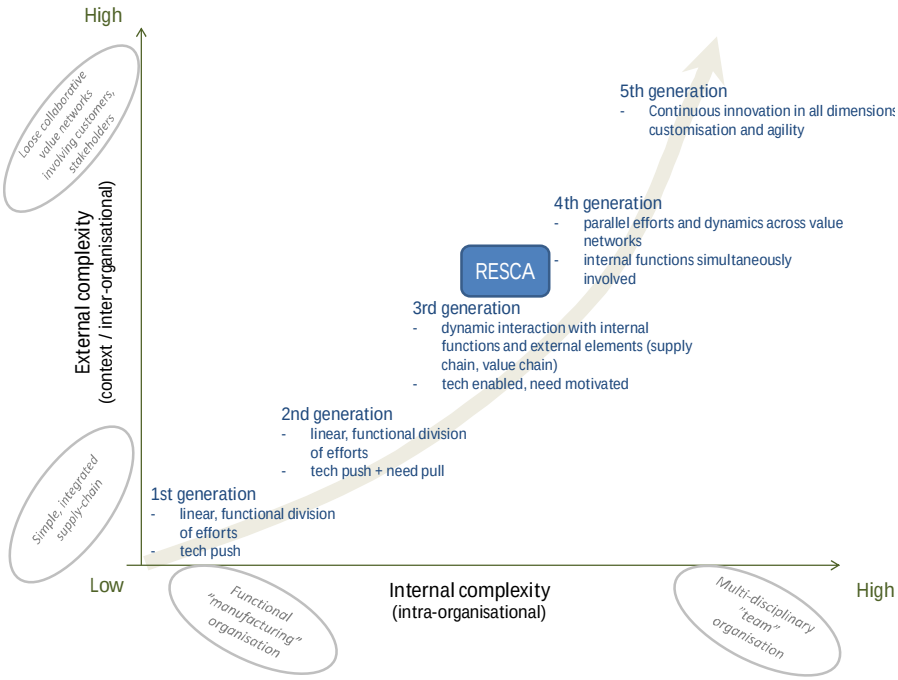

Figure 10. The maturity of RESCA in the innovation challenge scale.

7.3 Identification of innovation "hot-spots" and assessment of scaling-up potential

By innovation hot-spots we mean those phases and milestones in the processes of either RESCA or urban planning, where we judged that innovations actually took or could have taken place. The real hot-spots as far as we as researchers could identify was the initiation of RESCA when simultaneously acknowledging that the usual building code standard was not going to give results that were both aspired by the local building administration and already available in the market as ready-to-used applications or technologies. In this sense, the role of the administration and humble confession that they need to set new standards even if the national standards were the only ones really required and even if their action could be viewed as somewhat rebellious – at least in the eyes of some others.

The other hot-spot was that after the aforementioned acknowledgement had been made, the administration quite genuinely allowed market actors (suppliers) to take steps and present their ideas, and furthermore, to actually realise these ideas without any risk that administrational or regulatory standards could be made to work against these ideas. In plain words, some risk-taking was allowed and even encouraged.

The rest of the story of RESCA's innovations remains to be tested in practice and judged by the market. This will inevitably take time and require efforts from the supplier side to convince their potential customers that new solutions and applications work. In the demand side, the experiences of as well as the example set by Oulu building administration are vital and similar type of convincing is needed to persuade other city administrations to take the same steps. The core substance can be anything, not just energy efficiency, and may be associated with number of urgent urban development issues, for instance elderly housing, physically activating dwelling surroundings, concepts bringing generations together, social cohesion, civil society strengthening models, etc. These are plenty, but to achieve not just one of the targets but several at the same time requires more than incremental steps and piloting projects. An integrated approach is truly calling for a systemic change where processes of planning, decision making and market functioning will all need to renew.

Having said this, the scaling-up of mere energy efficient solutions seems perhaps not that challenging and should not the scale-up take place, the root problem must lie in the planning standards, regulations and decision making systems' rigidity.

The scale-up scope at this stage is primarily domestic. Many of the companies that have worked with RESCA solutions rely mainly on domestic markets. However, this is not to say that some particular technologies would not have potential to become products or solutions for export. But these efforts must first and foremost be done by the companies themselves. A great deal of after-pilot support is available, though, from the public side in the form of appearances in international *fora*, hosting delegations from abroad, and so forth. Research is also a a useful tool if utilised wisely. Researchers appear in international conferences, events, projects and publish globally. The value of such efforts could be indispensable and serve as a stepping stone for prospective and willing companies to access new markets.

Acknowledgements

The authors acknowledge the following in supporting this research: Tekes – the Finnish Funding Agency for Innovation, VTT Technical Research Centre of Finland, University of Oulu, staff of City of Oulu, most of all Mr. Aki Töyräs and Mr. Pekka Seppälä. We also acknowledge many good colleagues who have been more or less associated with our efforts: Mr. Ville Valovirta from VTT and Mr. Tuomo Kinnunen from University of Oulu.

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Series title and number

VTT Technology 195

Title	**Innovation architecture of renewable energy solutions pilots in Oulu** InnoCity project case study
Author(s)	Aki Aapaoja, Pekka Leviäkangas & Veli Möttönen
Abstract	Innovation in urban environments has become increasingly important as many of the great challenges of our societies are underpinned by dynamics in urban surroundings. The challenge with innovations in urban environments is that many of them do not diffuse easily. This is typically due to the nature of urban innovations: they comprise complex entities consisting services, technologies, physical assets, and social practices – all these linking together a heterogeneous set of actors. Many types of partnerships between firms, authorities, and other actors are often needed. This report introduces and concentrates on one particular case project Renewable Energy Solutions in City Areas (RESCA). The project was located in the city of Oulu in Northern Finland. RESCA attempts to generate reasoned and reliable concepts to guide and help builders, developers and planners in choosing and combining renewable energy sources for single-family homes. Adopted solutions and concepts had to be simple to use, effective and they needed to be applicable to be used in the Building Supervision Office's quality guidance process. Additionally, concepts needed to be applicable in other cities as well. The objectives of this report are to identify the challenges related to urban innovation processes and their scaling-up, using RESCA project as an empirical case. In addition, the aim is to find the key points where innovations actually took or could have taken place. Findings implicate that one of the most important hot-spot was the role and attitude of the local building administration when they acknowledged that the national building code standard did not offer the quality level or the functionalities that were aspired by the local building administration and supplied already by the market as ready-to-used applications or technologies. The other hot-spot was that the administration quite genuinely allowed market actors (suppliers) to take steps and present their ideas, and furthermore, to actually realise these ideas without any risk that administrational or regulatory standards could be made to work against these ideas.
ISBN, ISSN	ISBN 978-951-38-8189-4 (URL: http://www.vtt.fi/publications/index.jsp) ISSN-L 2242-1211 ISSN 2242-122X (Online)
Date	November 2014
Language	English, Finnish abstract
Pages	44 p.
Name of the project	InnoCity - Scaling-up Complex Urban Innovations
Commissioned by	
Keywords	Innocity, innovation, innovation processes, urban innovation, RESCA
Publisher	VTT Technical Research Centre of Finland P.O. Box 1000, FI-02044 VTT, Finland, Tel. 020 722 111

Julkaisun sarja ja numero

VTT Technology 195

Nimeke	**Innovaatioarkkitehtuuri Oulun RESCA -projektissa** Innocity -projektin case -raportti
Tekijä(t)	Aki Aapaoja, Pekka Leviäkangas & Veli Möttönen
Tiivistelmä	Jotta kaupungit voivat vastata suuriin edessä oleviin haasteisiin – liikkuvuuden helpottamiseen, hiilijalanjäljen pienentämiseen tai käyttäjälähtöisyyden parantamiseen – on kehitettävä uusia innovaatioita ja hyödynnettävä niitä laaja-alaisesti. Kaupunkien haasteiden ratkaiseminen tarjoaa samalla runsaasti liiketoimintamahdollisuuksia yrityksille, jotka pystyvät tarjoamaan innovatiivisia tuotteita ja palveluita näihin tarpeisiin. Ongelmaksi ovat osoittautuneet kaupunkiympäristön innovaatioiden käyttöönotto, levittäminen ja skaalautuminen. Erityiseksi haasteeksi on osoittautunut kompleksinen toimintaympäristö, joka koostuu eri käyttäjäryhmistä ja monimutkaisista julkisen, yksityisen sekä kolmannen sektorin toimijoiden verkostoista. Tässä raportissa keskitytään Oulussa toteutettavaan RESCA -projektiin (Renewable Energy Solutions in City Areas), joka keskittyy luomaan valintakonsepteja pientalon erilaisille energialähteille ja niiden yhdistelmille sekä niihin soveltuville energiatehokkuusratkaisuille. Projektin tavoitteena on hyödyttää sekä rakentajia että myös Oulun kaupungin rakennusvalvontaa ja alueen toteuttavia yrityksiä. Projektissa yritykset voivat kehittää omia ratkaisujaan ja samalla rakennusvalvonta saa tärkeätä tietoa uusiutuvan energian käytöstä. Parhaimmista käytännöistä muodostetaan Oulun alueen rakentajien ohjauskonseptit, joita voidaan monistaa myös muille paikkakunnille. Tämän tutkimuksen tavoitteena oli löytää ne vaiheet ja tilanteet, joissa innovointia ja innovaatioita oli tapahtunut ja joita olisi mahdollista hyödyntää muuallakin. Yksi näistä tilanteista oli se, että Oulun rakennusvalvonta lähti laadun parantamiseksi itsenäisesti kehittämään rakentamisen ohjausprosessejaan, koska kansallista rakennusmääräyskokoelmaa noudattamalla hyvään laatuun ei päästy. Lisäksi on huomionarvoista, että rakennusvalvonta antaa yrityksille mahdollisuuden kehittää toimintaansa ja kokeilla innovatiivisia ratkaisuja tarjoten tukea parhaansa mukaan, samalla pyrkien olemaan vaikeuttamatta innovatiivisten ratkaisujen soveltamista ja kokeilua.
ISBN, ISSN	ISBN 978-951-38-8189-4 (URL: http://www.vtt.fi/publications/index.jsp) ISSN-L 2242-1211 ISSN 2242-122X (Verkkojulkaisu)
Julkaisuaika	Marraskuu 2014
Kieli	Englanti, suomenkielinen tiivistelmä
Sivumäärä	44 s.
Projektin nimi	InnoCity – Scaling-up Complex Urban Innovations
Rahoittajat	
Avainsanat	Innocity, innovation, innovation processes, urban innovation, RESCA
Julkaisija	VTT PL 1000, 02044 VTT, puh. 020 722 111

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ISBN 978-951-38-8189-4 (URL: http://www.vtt.fi/publications/index.jsp)
ISSN-L 2242-1211
ISSN 2242-122X (Online)