

# Governing the Smart Sustainable City

## The case of the Stockholm Royal Seaport

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**Abstract**—The aim of this paper is to improve the understanding on how city administrations can integrate ICT solutions for urban sustainability into processes of planning, i.e. how to govern the Smart Sustainable City. The paper is based on a case study of how the City of Stockholm has worked with integrating ICT solutions in the urban development project the Stockholm Royal Seaport (SRS). Through interviews with city officials and analysis of planning and policy documents we track how ICT became a part of the environmental program for the SRS, how this type of technology is conceived in terms of relation to the planning and implementation of other urban technologies, as well as what expected effects are highlighted. For this specific case we also distil some general lessons learned regarding what worked well and what did not. Finally, we draw conclusions regarding how ICT and sustainability can be merged in the planning phase of new urban developments and, ultimately, how a city administration can govern a city towards a Smart Sustainable City.

**Index Terms**—Smart City, Sustainability, Governing

### I. INTRODUCTION

Urban planning traditionally relates to ICT as a tool to facilitate and improve the planning practice per se, e.g. through supporting communication and interaction across and within public authorities and citizen communities, for ballots, as well as for visualizing proposals and results [1]. The smart city discourse however emphasizes another role for ICT: as a distributed infrastructure of meters, servers, computing capacity and interfaces together forming a sort of digital nervous system for the city, facilitating the management of urban infrastructures and services [2, 3]. In contrast to previous ICT-based urban visions of ‘digital cities’ where ICT was seen as a way to develop a digital representation of the city for citizen networking and e-governance [4] the smart city vision thus calls for a full integration of the city’s physical and digital layers [5]. For this vision to realize, there is a need for an integrated social layer of actors and institutions, planning, implementing and managing the ICT infrastructure. Besides ICT companies, this social layer must also include other stakeholders, such as utility companies, architects, urban planners of all sorts, energy cooperatives etc. Without these actors the potential of ICT to make cities more sustainable will to a large extent be left unharnessed or even (unwillingly) counteracted. Developing the Smart Sustainable City from a City administration (i.e. an urban municipality)

point of view thus becomes a matter of coordination, or orchestration of the development and management of the ICT infrastructure.

In Sweden, City administrations are comparatively powerful when it comes to the planning of urban infrastructures. Besides the spatial organization, municipalities may also make demands on technical characteristics and performance. However, once the infrastructure is in place, the management and use of these systems is typically left to companies (which due to privatization have become increasingly private) and users. The same distribution of responsibility can be seen when looking at the ICT infrastructure, where the remit of urban planners includes making sure that fiber-optic cabling is installed [5]. As any other infrastructure, the ICT needs to be planned, implemented and managed. In contrast to the infrastructure for energy, water, waste and transportation, which at least in Sweden has remained more or less the same for many decades now, the infrastructure of ICT has changed dramatically, and is still changing. The infrastructure of ICT that we know today is a radically different system than it was just thirty years ago. Key changes in this system include the invention and roll out of Internet, the development and dissemination of mobile communication equipment (mobile phones), and the increasing number of connected devices, often referred to in terms of the Internet of Things (IoT).

This implies that for a city to become smart, the City is fundamentally dependent on the initiative by and interest of other actors – that *developers* see it as relevant to install smart metering devices, that *energy companies* see it as relevant to provide information about energy use to their customers, that *inhabitants* see it as relevant to equip their homes with ‘smart’ appliances – and, moreover, that the initiatives of these different actors in some way are coordinated so that they can in fact support each other. Otherwise there is a risk that technology is not implemented all the way, as in Hammarby sjöstad, a high-end urban development project in Stockholm where installed displays intended to show real-time energy use have no information to deliver ten years after installation [6].

The aim of this paper is to improve the understanding of how City administrations can integrate ICT solutions for urban sustainability into processes of planning, i.e. how to govern the Smart Sustainable City. The paper is based on a case study of

how the City of Stockholm has worked with integrating ICT in the urban development project Stockholm Royal Seaport (SRS). We are especially interested in exploring if, how and to what extent ICT-topics became integrated in the ambitions of building a sustainable city. We build the study mainly on experiences from a number of civil servants from different City administrations, together comprising the SRS planning organization.

The paper is organized as follows: after an introduction to the Stockholm Royal Seaport, the concept of Smart Sustainable Cities is introduced in Section II. Section III presents the concept and theories of governance, and introduces the analytical framework. Section IV presents the methods used and Section V reports on the results. The final Section VI concludes the paper.

#### A. Introducing Stockholm Royal Seaport

SRS is a new city district located in the northeast of the City of Stockholm. Planning of the area started in the early 2000 and the first inhabitants moved in 2012. The district is expected to be fully developed in around 2030 and will then include 12 000 new apartments and 30 000 new work places. SRS is currently one of the largest areas with an environmental profile being planned in Europe at the moment. However, it was not until 2009, several years after the planning of the first stage of the SRS, that it was decided to give the area an “environmental profile”. In 2009 the SRS also joined the Clinton Climate Initiative, strongly marketing the environmental profile of the area. Due to its environmental profiling, technological solutions, and proactive work with climate adaptation, the SRS development has attracted a lot of attention and research interest, and the City of Stockholm market this as an arena for innovation and sustainability.

## II. ICT IN THE SMART SUSTAINABLE CITY

Drawing on Höjer and Wangel [7], this paper defines a Smart Sustainable City as a city that meets the needs of its present inhabitants without compromising the ability for other people or future generations to meet their needs, and thus, does not exceed local or planetary environmental limitations, and where this is supported by ICT. Similar to this, the ITU-T [8] also point out that it is the use of ICT that defines ‘smart’.

However, only focusing on the ICT per se risks downplaying the complexities at hand for realizing the Smart Sustainable City. First, in order to successfully plan for, implement and manage ICT for sustainable cities, this must be addressed as (parts of) a system – i.e. an Information and Communications System (ICS). A systems perspective is essential to identify and manage gaps, conflicts and synergies between different ICT – in terms of functionality, accessibility, ownership, etc.

Secondly, and relating to governance, this system must be seen not as a technological, but a socio-technical system where technology exists in and interacts with (in) a social context, comprising formal (e.g. laws, regulations, standards) and informal (e.g. norms, practices and values) institutions at multiple [4].

Thirdly, ICT is characterized by the resource it deals with – information. While this information sometimes deals with information about data (e.g. how many megabytes), in the context of Smart Sustainable Cities, the information collected, analyzed and transmitted often refer to other types of resources or phenomena – kWh used, the number of cars on a road, the concentration of pollutants in the air, the location of buses etc. Thus, planning for the Smart Sustainable City cannot be delimited to ICT alone, but must also incorporate and recognize connections to other socio-technical systems such as the energy system, the waste management system, the transport system,

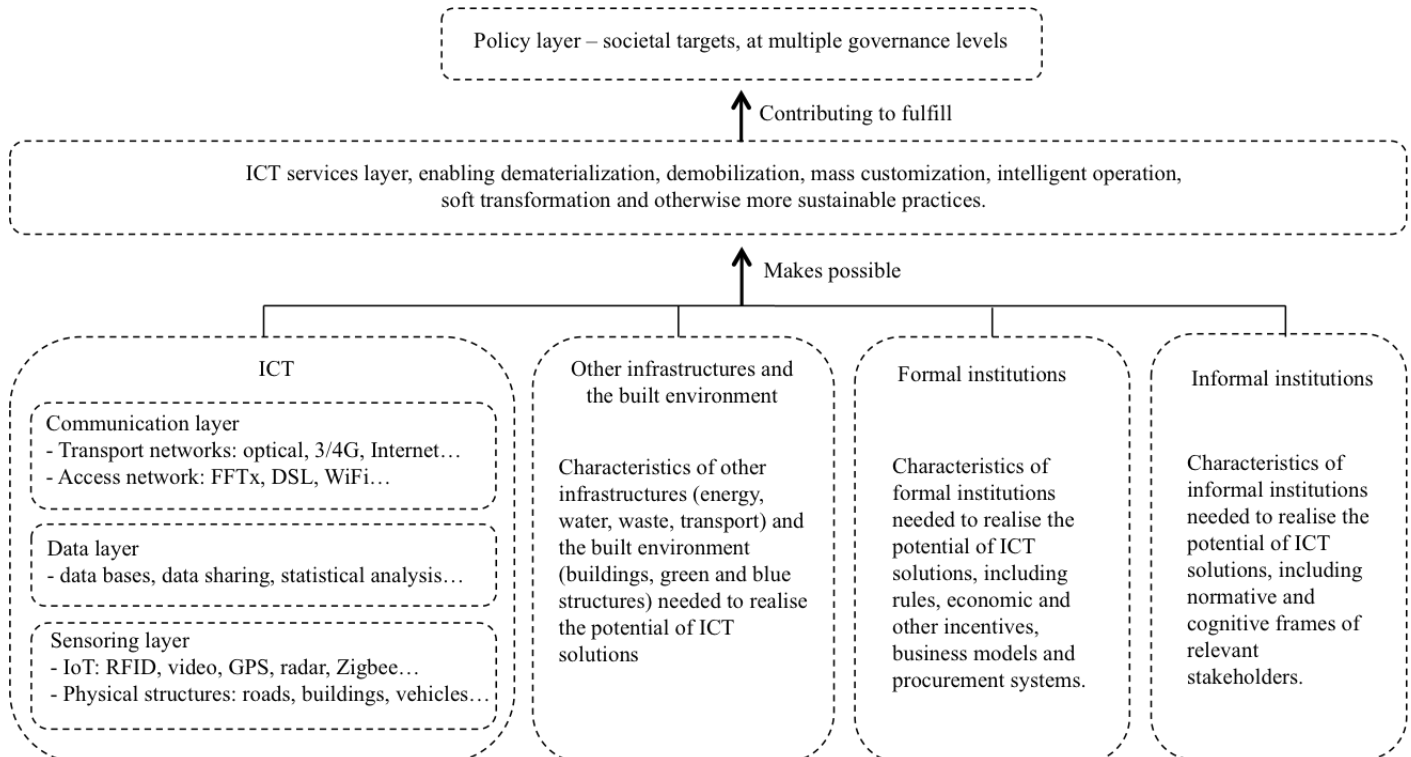


Figure 1. The multi-layered socio-technical system that needs to be addressed when planning for Smart Sustainable Cities.

and buildings. The Smart Sustainable City-as-system thus emerges as a socio-technical assemblage of technologies, services, buildings, business models, organizations, regulations, users, norms, dreams and fears (Figure 1).

### III. ANALYZING GOVERNANCE

The key function of governance is to make and implement policy [9]. However, besides this governance should also be efficient, so as to not use more of societal resources than is necessary to achieve the intended outcome, and it should be just, in that it should not in a structural way prioritize certain societal groups over others.

One, common, way of studying governance is by looking at the institutionalized, formal dimension of governing. This includes formal institutions such as laws and regulations controlling how governance should be carried out (e.g. the Swedish Planning Act) as well as policy documents stating societal targets (e.g. the Environmental Program of the Royal Seaport). From this perspective, governance, and especially the governance of urban planning, appears as a linear and step-wise ‘event-sequence model’ [10]. Such a technocratic approach to governance is however problematic as reality tends to be a whole lot messier than that [11]. Instead a relational model of governance is proposed, in which actors, agency and relationships form the core of analysis [12]. Moreover, governance may also be understood to include informal dimensions, such as the discursive ‘logics of appropriateness’ provided by normative and cognitive rules [13-15] and informal power relations [11] influencing how formal institutions are interpreted and played out in practice.

Governance can also be subdivided into different dimensions, such as structure and process, each of which can form an object of study in its own right [9]. As for structure, governance can be understood through any of the metaphors of a hierarchy, a network, a community, a market – each providing a different discursive lens through which “good” can be understood and analyzed, especially regarding the role of government (steering, nudging, enabling...), what stakeholders are seen as relevant or necessary to include and by what reasons (instrumental and/or normative), and how the distribution of power should look [9, 16, 17]. Understanding governance as process instead puts focus on how governance is carried out. Here the metaphors of steering, coordination and self-organization are essential. Looking specifically at the role of government in relation to Smart Sustainable Cities, the metaphor of a platform has been put forth as relevant, encompassing the two sub-metaphors of ‘the vending machine’ (with a pre-defined set of functions and services) and ‘the bazaar’ (an open platform) [18].

#### A. Network Governance and Meta-Governance

One particular type of governance is network governance, defined by Sørensen and Torfing as “1. *relatively stable horizontal articulations of interdependent, but operationally autonomous actors*; 2. *who interact through negotiations*; 3. *which takes place within a regulative, normative, cognitive and imaginary framework*; 4. *that is self-regulating within limits set by external agencies*; and 5. *which contributes to the production*

*of a public purpose.*” [19]. It has been argued that the way in which Western societies are being steered today reflects a fragmentation and transfer of power and responsibility from governments and public bodies of the representative democracy to private interests, NGOs and lay people [20]. The more networked types of governance do indeed involve a number of potential benefits such as increased legitimacy, the creation of social capital, citizen empowerment and stakeholder buy-in (see e.g. [21] p. 4-5), but are also questioned in the way these modes of governance influence democratic concerns such as accountability, representation and transparency [22-24], as well as how effective these types of governance are in regards to driving more radical changes, such as sustainable development [25]. Sørensen and Torfing thus define four principles for *democratic networks governance*, according to which networks should be 1) controlled by democratically elected politicians; 2) represented by members of relevant groups and organizations; 3) accountable to the territorially defined citizenry; 4) follow democratic rules. The issue of network control connects well to the concept of meta-governance, by which administrations representing government (i.e. public authorities at multiple levels) take on the role as meta-governor (i.e. spider-in-the-web) of the governance network through any or a combination of four meta-governing techniques: network framing, network design, network management and network participation [26]. All in all, those techniques can be seen as a description of the platform requested in previous section.

#### B. Developing an Analytical Framework

Since the combination of network governance and meta-governance fits well with “the Swedish model” of governance [27] it was decided to base the analytical framework on these two approaches. Consequently, in addition to exploring the public administration as governing organization it is also relevant to analyze in what ways other stakeholders have been involved in the process. Given that planning for Smart Sustainable Cities is a rather new task for planning administrations, the framework was also designed to support the identification of planning and policy-documents of relevance, decisions and deliberations, and experienced challenges. In short, the resulting framework includes the following main categories of inquiry:

- Roles and responsibilities
- Participation and representation
- Decision and working process
- Challenges

### IV. METHODS

Primary data was collected through a group interview to which participants were selected from the on-going planning project of Stockholm Royal Seaport (SRS), and came from three different organizations within the City of Stockholm. Out of the eight participants one came from the City Planning Office, five from the Development Administration, which had focus on the construction project, the environmental plan as well as specific activities related to the environmental profile

and two on ICT related questions, and two came from the SRS Innovation Arena.

The group interview was semi-structured, and the interview guide was developed based on the analytical framework (see Appendix A). Findings were reported as statements relating to the analytical framework, and included both complementing and conflicting statements. In addition to the group interview, written material such as plans, programs, policy documents and project descriptions were identified and analyzed.

To prepare for the group interview, and to get an understanding of the complexity of the SRS project, a mapping of ICT projects within the SRS was carried out (see Appendix B). The mapping was carried out in workshops with representatives from the City of Stockholm, companies and academia as well as through interviews with representatives from City of Stockholm and from the Internet [28].

## V. RESULTS

The results below follow the same headings as we used in the interview guide (see Appendix A).

### A. Roles and responsibilities

The SRS planning organization comprises several different roles from different parts of the City of Stockholm organization: *The City Planning Office*, *the Development Administration*, and *the SRS Innovation Arena*. The formal roles of organization in the SRS are the same as in other projects, i.e. *the City Planning Office* is responsible for the comprehensive plan, the detailed development plan and the building permit. [29]. *The Development Administration* has two main roles: as landowner and as commissioner of development. In the role as landowner it is possible to set more comprehensive and ambitious environmental targets than what is possible in the role as an authority. *The SRS Innovation Arena* is an arena for the City of Stockholm, experts, businesses and citizens. SRS Innovation is working as a facilitator for the innovation processes connected to the SRS.

#### 1) Roles in relation to SRS in terms of ICT-solutions

When it comes to the organizations' roles in relation to SRS in terms of ICT-solutions *the City Planning Office* has a limited role and responsibility and is mainly concerned about jurisdiction. Their role in this project is to make use of the learning from ICT-projects in the SRS and transfer the new knowledge to steering documents used by the City of Stockholm.

At the *Development Administration* the employment profiles do not include ICT as a focus area. There were no employees with expert knowledge in ICT or how ICT could contribute to reach environmental targets in the SRS planning organization. The interviews revealed that people working there thought that ICT could be used to reach climate targets. The idea to use ICT to reach environmental targets came from city servants working with the environmental plan. They had discussed different ways to communicate and visualize energy use by ICT solutions. According to one of the respondents: "Changes in lifestyles and habits have been discussed in con-

nection to ICT applications from the beginning. ICT thus comes in when it's relevant to other issues."

Two persons were therefore appointed by the Development Administration to have ICT as their primary focus. One was appointed as IT strategist and works mainly with technical issues such as implementing the ICT infrastructure, which is the City's primary responsibility. One of the respondents said: "When it comes to responsibilities, the ICT infrastructure can be compared to the road infrastructure. The City is responsible for the maintenance and operation of roads but not what is transported there."

The interviews also showed that there was a lack of environmental targets connected to ICT. The other person (a consultant) was therefore appointed to develop a digital city plan to make use of ICT to reach environmental targets in the SRS (the consultant was employed during the autumn of 2014). The digital city plan for the SRS should be a combination of a vision and a plan to achieve the environmental targets. The digital city plan should include both technical and governance issues such as: What is the jurisdiction of the City when it comes to ICT solutions? What processes, contracts and documents exist that the City needs to relate to? What roles and responsibilities related to a digital city plan is missing in the city administration? The work with ICT issues has been divided into three themes, buildings, smart and sustainable system solutions and new business and financial models.

*The SRS Innovation Arena* has a role to be a pilot arena for new innovations and to build knowledge on requirements that needs to be defined in order to achieve wanted effects. Both the SRS project and the SRS Innovation Arena are involved in areas where the City of Stockholm usually don't have jurisdiction. One of the respondents said: "The SRS Innovation Arena is free to look at areas and solutions that would be nice to have but are outside the ordinary jurisdiction of the City."

A network, focusing on ICT issues, with participants from different parts of the administration of the City of Stockholm, has been launched due to the needs that have been identified in the SRS. Since the participants have had a lack of both knowledge and organization for handling questions related to ICT, the network had an important role to share knowledge.

#### 2) Responsibility for requirement definition, development, implementation and operation

*Requirement definition* - The exploitation itself is used as a governance opportunity in the SRS. When negotiating contracts with developers, it allows for making demands on technical infrastructure and metering spots to collect data. The agreements used in the exploitation process are binding. The City has not required the supply of different services from the developers. But they can indirectly stimulate demands for services by the way they act.

*Development* - The ICT-solutions are not only a private concern. There is a need for an ICT infrastructure as well as

embedded systems in public functions such as public spaces and transport systems. It demands the involvement of other actors, such as utility companies, the Transport Administration and Stockholm Public Transport. ICT solutions are needed both indoors and outdoors.

*Implementation* – Among the respondents one told: “The large challenges when shaping the new marketplaces are to create new business models, new ways to collaborate and new ways to distribute risks.” On a systemic level, there are barriers that need to be understood in order to support the development. New knowledge needs to be developed on how to contribute, invest and to share risks together with entrepreneurs in order to create future viable business models. Another respondent said: “These are the real issues the SRS project is dealing with every day, when we talk about sustainable urban development and conversion. New constellations of actors are being shaped along the process.”

*Operation* – The municipal organization is divided into technical responsibilities. With the new ICT solutions, different organizational and corporate boundaries are crossed, which makes discussions difficult and complex.

## *B. Participation and representation*

### *1) Participating actors*

While more things are being connected, more actors will be affected of different ICT solutions. All the municipal administrations, the county council, the companies owned by the municipality, the National transport authority and everyone owning something within or adjacent to SRS have a role in these solutions (the built environment, infrastructure, plants, etc.) and thus need to participate in order to get the solutions in place.

The municipality has a role to try out new technical solutions and to test new markets by purchasing new technologies. The tenement houses owned by the municipality can be used to test and to showcase what works well and what does not.

In the Smart City SRS project (a type of control center for the city to collect and monitor data) it has been shown that there is need for a new type of operator and integrator of services. The City has invested in developing the platform initially and the idea is that a private actor should take over the responsibility for the platform and enable many different service providers to use and also run their services on top of the platform.

One of the interviewees told: “A smart lamppost is used as an example to showcase the complexity of how many different stakeholders are involved. The lamppost contains lighting, which can vary according to needs, sensors that listen to noise and measure air-quality. It is a mast for mobile communication and WI-FI as well as a charging station for electricity cars. Who shall own it? Who shall operate it? Who shall pay for the fiber cable? Who shall pay for the electricity bill? The lamppost has traditionally been owned and operated by the municipality but now when it becomes smart it might be other actors that should be responsible together with the municipality.”

### *2) Missing actors*

In SRS it is definitely the end-users/citizens that are missing. At the time for the interview the new parts of SRS with the environmental profile are being planned.

During the planning of the SRS it has become obvious that there is a lack of competence in sustainability questions and specifically in environmental questions. There is also a lack of competence for procurement of ICT solutions. There is need for someone with knowledge about the City that also has knowledge about ICT.

Lawyers and business developers are also missing. There is a need for lawyers that could take a look at jurisdiction and contract issues. Business developers need to support the development of new business models. Many of the questions that have been raised are about finding new business models and new ways of co-operation.

### *3) Representation of interests in the process*

It is very sparsely dealt with ICT in the planning and building act (PBA). There are a couple of rules that control and steer different physical pipes, for instance where they are drawn.

Stakeholders have not dealt with ICT issues specifically, except for the issue of mobile coverage. The issue of mobile coverage is an example when PBA and questions around the digital network doesn't work and where the connection needs to be developed. There are also market dependent issues where the mobile market is divided in vertical pipes. It's both the market logistics and the PBA, which makes it difficult to provide mobile coverage indoors. One respondent clarified: “It would have been desirable that the ones who deliver digital networks should have gotten information about that the houses are too sheltered for mobile digital signals. There is no mobile coverage indoors since the digital signals cannot pass the walls due to new and better shells to reduce energy use.”

### *4) Citizen participation*

In SRS phase 1 (which was ready when we made the interview) there have been consultations with citizens, as in any planning process. The municipality works with dialogue processes to create an active dialogue with the citizens. In these processes they gather input on topics that are important for the citizens. In SRS there has been a citizen network dialogue with information to the citizens related to different issues. Open meetings have been held where residents have been invited to get information and discuss different topics such as town farming, travel information etc. One of the respondents said: “The citizens needs and demands have their focus more on that the busses are coming in time, that there are playgrounds for the children, that there are parking lots and that the shops are not closed. But they are also engaged in that different ICT systems works as they were meant to. For example, that the meters at the parking lots works. The citizens were also very engaged when it showed that the mobile coverage didn't work indoors.”

Citizens have been involved in idea-generation in development projects. Companies, who want to have input and is not part of the planning process, typically drive these processes. There has also been an innovation workshop in SRS together with residents, which resulted in two suggestions on car shar-

ing, that are now on their way to be implemented. But these are outside the formal planning process, and more of research and development types of projects.

### *C. Decision and working process*

#### *1) Initial ICT plans*

The SRS project started in 2001, and the environmental program was established in 2009. Ideas about strategic implementation of ICT came with the environmental program. The program included requirements that SRS should be smart in some way, requirements that civil servants have tried to interpret since then. When it was declared that SRS would be the new Stockholm lighthouse project for low environmental impact this resulted in a lot of attention from several actors who started a number of research and development projects with the word smart. One of the respondents described how it started: "The Stockholm based telecom company Ericsson was the first company that gave a presentation on "Smart Sustainable Cities", which had a wow-effect on us in the city. We didn't know it was possible to think like that. It was like two different worlds met, the telecom world and the world of city building." Before the environmental profile, City of Stockholm had only worked with Nasdaq and OMX in the IT/Telecom-sector to make a plan for secure trade in Stockholm. There was no digital plan from the start. Initially there were several inspiring meetings with research institutes and companies, but it was hard to realize the ideas. One of the respondents said: "First we thought that ICT belonged to the lifestyles team, because it was seen as a way to make lifestyles more sustainable. But then we understood that this was a technical issue. The project "Smart ICT for living and residing in SRS" was a starting point for many of these questions."

#### *2) Plans today (Spring 2015)*

The SRS project has gained a lot of experience, which has developed through the different development and research projects. The project tries to leverage from the learning's they have made in the ongoing development- and research-projects in SRS rather than making a business intelligence outlook. Questions about the agency of the public and what is the markets responsibility are sorted out by analyzing ongoing projects to understand where system borders should be drawn. A more concrete digital plan is being developed. One respondent explain: "Right now we are working on securing structures and databases for collection of data that can be used to give feedback and inform inhabitants and also sort out a viable business model for the data collection unit."

#### *3) What discussions have been held?*

The civil servants describe several inspiring meetings with research institutes and companies initially. But it has been hard to realize the ideas and to understand how to work together, since there were so different perspectives. One of the respondents remember: "When we met with Ericsson it was like someone showed us a Christmas tree with Christmas balls that shined and sparkled. But, we didn't understand how we could reach each other"

The City administration has been cautious to accept ideas and approaches from one specific company, because of concern that they would loose control over the process. .

When discussing transportation issues the City got support from experts in transport issues, but when discussing ICT-questions there were no experts or knowledge in the field available due to its newness to planning issues. It's a completely new technology area in the planning of urban areas, which require special attention and needs to be coordinated through a new function. The environmental coordinator looked at research and development projects to get support to set requirements in the action program towards the developers.

The work with the environmental program was divided into different groups. Since ICT was considered having the potential to change habits and lifestyles it was the group with focus on lifestyle questions that initially got the responsibility to work with ICT questions.

One of the respondents told: "When I joined the project in 2011 the responsibility for ICT was with the environmental coordinator at the City District Administration that had no knowledge in ICT questions. "

#### *4) Decisions and deliberations about investments*

The investments made by the city administration are quite limited. There might be larger investments in more specific sectors like the school or care sector. But these investments are not part of the exploitation.

The exploitation is used as a governance opportunity. An action plan has been developed and presented to the steering group for the exploitation. The steering group decides upon the objectives and the action plan in a systematic process. Objectives and action targets guide investment decisions (also for ICT investments). The steering group also decides over measures needed to be able to meet the fulfillment of targets.

A developer signs the exploitation contract, agreeing to do certain things, for example to add fiber-cable to the building and give back information on the use of energy, water etc. in certain predefined spots. In this case it's the developer that make the investment.

To be able to collect environmental data the City administration has invested in a platform that can collect data (Smart City – SRS). The portal with information to the citizens is an investment that has been regulated in the exploitation agreement. It's the property owners who need to do the investment for their tenants, so they can get information about resource use. The data should be reported back to the city administration in a coordinated way. One respondent said: "In a conference with focus on Smart cities held in Stockholm the conclusion was that in many cities around the world, there is a lack of an organization that can orchestrate the vast flora of different systems. It was clear that they had neglected and not realized the importance of such a function in the cities."

### *D. Challenges*

When asked to identify challenges for Smart Sustainable City-development in the Stockholm Royal Seaport, a number of themes could be identified.

*Lack of vision* - The vision supposed to guide the development of the digital city plan is not clear enough. The issue has not been addressed within the city administration.

*Lack of experience and competence* - There is no experience within the City for working with ICT issues in urban planning. There is a lack of competence on ICT in the SRS team and in the City as a whole. There is also a question on how far the City should engage in these issues. ICT is a new technological area and it takes time to learn.

*Difficult to envision* - The physical building process is easier to understand since it is tangible and its possible for all stakeholders to have an opinion about it. Since ICT is abstract and not possible to see. It's difficult to envision how the cooperation between the ICT and urban renewal should look like. Power point with its communication limits is used to illustrate what it could look like.

*Interaction between individuals and environment* - One large challenge is to understand how the interaction between individuals and the environment takes place. Environment means here buildings, public spaces and various transport solutions. By studying the interaction between individuals and the environment, different roles/responsibilities becomes visible. For example, the ICT can affect a buildings temperature. If there is a requirement on energy-optimization, the system can automatically adjust to the given requirement without involvement of the individual.

*Stakeholder involvements* - A lot of stakeholders need to be involved in the innovation process. What are the actor's involvement and characterization of involvements? For example it has been difficult to engage construction companies in different pilots. Are these projects meta-governed in any way? What are the connections between the different sub-projects? Are the same individuals and/or organizations involved in more than one project? Are there any procedures for knowledge transfer?

*Long time horizon* - It is difficult to negotiate agreements for an area that is going to be built during 2017 (two years from now) and where inhabitants move in during 2019. It should have been easier to set requirements and test out solutions in an already built environment where different actors are in place. At the same time the mix of ICT solutions will be different in 10 years time.

*Short time horizon* - Investments are hampered because economic analyses are too narrow in scope and time. There are many types of costs and benefits that need to be included, and the time span needs to be expanded. In the short term investments seem too costly, but if the time span is increased a different picture might appear.

## VI. CONCLUSION

The SRS planning organization has taken a stepwise approach to implement the Smart Sustainable City rather than to buy a specific company's approach. The reason for that is to build knowledge within the organization and adjust the organization accordingly.

To use ICT in support of the environmental program is new to the city. In that sense the ICT technology is new and there is no function to handle issues around it. ICT is comparable to

other infrastructures like energy and transport and need their specific organizations and experts.

In the SRS project the formal organization has been working in parallel with the SRS Innovation Arena. They have had different roles, which have been good for the knowledge built up. The SRS Innovation Arena has had a more experimental role.

It has been shown that it's an opportunity to use the exploitation contract to set new demands on the developers. There are also opportunities for the municipality to act in different ways to stimulate demands. Other stakeholders than the SRS planning organization itself make most investments in ICT technologies.

It is the barriers on a systemic level that needs to be understood and dealt with in order to put the Smart Sustainable City in place. There is also a need for a stimulation of new and viable business models that makes the new solutions to take off.

In the formal processes (the Swedish Planning and building act) it's very sparsely dealt with ICT questions. In a new area like Smart Sustainable City it is difficult to engage the end-users, the ones that are going to inhabit the district when it's ready.

The City administration itself did not have the idea to use ICT to reach sustainability targets. It was the IT-companies that knocked on their door.

During the years 2015-2016, several things changed in the City of Stockholm relating directly to the issues described in this paper. For example, an "ICT-network" was established. It connects civil servants across the parts of the City of Stockholm to find a more comprehensive way of using ICT. Moreover, the previous IT-department of the City was changed both in terms of name, leadership and tasks and is now (2016) called "Digital development", and has a much broader take on ICT. This development towards an organization at central City level with responsibility for how ICT is used in the City is very promising, and hopefully lessons can be learnt from how the City started out with very vague ideas regarding ICT's importance at a lighthouse project, towards an inclusion of ICT in the central governance of the City. This is an ongoing process, and it still remains to see if and how the City manages to also incorporate a systematic work on using ICT to reach environmental targets.

## VII. ACKNOWLEDGMENT

We gratefully acknowledge the support from Vinnova and the partners to CESC - Centre for Sustainable Communication, [cesc.kth.se](http://cesc.kth.se).

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## Appendix A. Analytical framework for governance of Smart Sustainable Cities

Areas	Characterization
Roles and Responsibilities	<ul style="list-style-type: none"> <li>• Function, (overall, in relation to ICT solutions)</li> <li>• Connection/contribution to Sustainable development,</li> <li>• Power relation, (influencer, influenced)</li> <li>• Accountability (right accountability for the given role?)</li> <li>• Who is responsible for that the ICT solutions are               <ul style="list-style-type: none"> <li>– planned</li> <li>– developed</li> <li>– implemented</li> <li>– used</li> <li>– operated and maintained</li> </ul> </li> </ul>
Participation and representation	<ul style="list-style-type: none"> <li>• Which stakeholders and citizen groups are included?</li> <li>• Which stakeholders and citizen groups are missing?</li> <li>• To what extent are they included?</li> <li>• Representation of interest (corporatist or pluralist, inclusive or exclusive, active or passive)</li> <li>• Are methods to involve citizens applied in the process – to what degree?</li> <li>• Are the results of work transparent to the wider public and to what extent?</li> </ul>
Decision and working process	<ul style="list-style-type: none"> <li>• What plans were there on ICT solutions from the start?</li> <li>• What plans are there today?</li> <li>• What decisions and deliberations have there been about the ICT investment and how are they characterized? (consensus, voting etc.)</li> <li>• Are you aware of any formal policy documents, which directly or indirectly affect the work with ICT solutions for sustainable development?</li> </ul>
Challenges	<ul style="list-style-type: none"> <li>• What are the largest challenges regarding the planning for ICT solutions? (technology, finance, collaboration, laws or other?)</li> <li>• How could the challenges be addressed?</li> </ul>

Appendix B. ICT related projects in SRS in which the SRS planning organization has been involved

Projects in SRS	Short description	Area/sector	Stakeholders
SRS ICT-plan	An ICT-plan is being developed to describe the need of investments and the potentials with a functioning IT-infrastructure	Planning	City
Sustainability portal	A web-based monitoring tool for the development of the city district. The developers are able to directly fill in the results at each monitoring occasion.	Monitoring and follow-up, Data collection	City, Private sector
Construction Consolidation Center (CCC)	The CCC directs traffic and provides services to increase the efficiency of the logistics into the construction sites. The logged data consists of materials being brought in to the development and construction waste	Data collection -construction, Transport, Waste	City, Private sector, Academy
Web based Eco cycle model	A continuation of the project Eco Cycle 2.0 below. The projects aim is to develop the first version of the reflow-model as a web-based tool	Energy, Water, Transport, Waste, Sewage	City, Private sector, Academy
Citizens Communication Platform	A continuation for the Smart City SRS project. The aim is to develop a platform where information that simplifies life for the citizens in combination with sustainability information should be provided.	Communication infrastructure, Data collection	City, Private sector, Academy
The life puzzle	A booking system for shared resources, such a cars and hand-tools as well as services such as baby-sitting and dog walking. The booking system could be limited to one single house but could also be open to the neighborhood.	Communication infrastructure, Data collection	City, Private sector, Academy
Eco Cycle Model 2.0	A principle of how to design an explanatory model to describe the invisible flows of the city. The model should also describe how flows could be turned into eco cycles.	Energy, Water, Transport, Waste, Sewage	City, Consultancy firm, Academy
Smart City - SRS	Integrating and analyzing data from city sectors, including energy, water, waste and transportation to provide real-time feedback to city planners, industries, organizations, and citizens, can generate new insights and support better decisions through awareness of their consequences. The Smart City SRS project represents the joint collaboration effort of citizens, construction developers, waste, water, and energy utilities, as well as the city departments, to meet the vision of real-time feedback as outlined in the city's sustainability program for the Stockholm Royal Seaport.	Energy, Water, Transport, Smart Waste & Sewage	City, IT service providers, Academy
SPACETIME/ TRACS	It is important that people who will live and work in Stockholm Royal Seaport can travel efficiently and with as minimal environmental impact as possible. For this reason, Stockholm Royal Seaport is planned on the basis of a traffic hierarchy in which walking, cycling and public transport take priority over cars. The SPACETIME travel planner tool is being developed in order to make it easier for private and work-related travelling in Stockholm Royal Seaport. The travel planner lets the user search for different travel options, add journeys, make journey enquiries and coordinate shared travel easily.	Transport	City, County Council, SPACETIME, Transport Authority, Telecom Operator, Telecom supplier