Title:	The Resilient Smart City concept as a Business Opportunity for Engineering Firms
Subtitle	How Engineering Firms can create and grasp Resilient Smart City Business Opportunities through Business Model Innovation

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SUMMARY

Recently a tipping-point has passed. More people are now living in urban environments than outside of them. This situation provides our cities with a number of large challenges. For instance, how will the ever-growing cityscapes continue to be livable, despite huge pressure on environmental and infrastructural systems? Added to this, environmental issues, such as peak oil and climate change and goals and regulations related to these issues are forcing societies to rethink the way cities will function sustainably towards the future. And just as importantly, how can these issues be faced in a democratic way, focusing not just on technocratic solutions but on the actual needs of city dwellers? At the same time the Dutch government is taking an ever more back seat role in the spatial development of the Netherlands. Trends of declining budgets combined with liberalization mean that regional and urban development is increasingly dictated by economical forces, and less by government strategies and ideals. How then to realize viable solutions for the problems at hand? This is the question the Resilient Smart City (RSC) Concept is interested in.

This research first focused on the question what the RSC concept is and how it can benefit urban environments. Through an extensive literature review a RSC definition was defined: ***A Resilient Smart City is a city that Empowers its inhabitants to help it develop Efficiently and Sustainably through Resiliency Solutions***. This RSC definition is consciously set apart from traditional Smart City (SC) definitions through a number of qualities. It is aimed at goals and results, not at specific tools or techniques. Secondly, it includes end-user needs and steers away from technocratic solutions. Thirdly it believed the city is an ever-evolving entity, so it does not believe in fixed solutions. And finally, it involves an inclusive way of thinking. The sectorial approach often present in SC thinking is abandoned in favor of an integral approach. Steering away from the standard SC approach was a conscious choice towards a fresh viewpoint both scientifically and practically, away from the SC domain is often claimed to purely suit the needs of authors involved.

To research the practical implications and implementations of the RSC concept the focus then shifts to the question how Engineering Firms can grasp RSC Business Opportunities (BOs) and as such help implement RSC solutions whilst furthering their business interests. It does so by combining theoretical research into RSCs and BOs with a practical case study into RSC Business Opportunities at an Engineering Firm. The concept of Business Model Innovation (BMI) was used as a research framework, investigating innovations in the different areas of the Business Model to work towards a strategy to grasp BOs. The method was an ad-hoc, qualitative and explorative one, based upon desk research, discussions with stakeholders involved and concrete projects within the Engineering Firm.

A RSC vision, based upon the RSC definition acts as a proverbial dot on the horizon as to the possibilities of the concept and the direction of potential services. This vision revolves around higher-level city systems where needed based upon Resiliency solutions, that offer a solid framework for lower level city systems where possible based upon citizen involvement,

self-reliance and organic development. An extensive stakeholder analysis provides insight into how to approach the RSC marketplace successfully. The present situation and changing stakeholder roles and requirements for a RSC scenario are combined to envision stakeholder relationships within a RSC marketplace. Results indicate that because of the newness of the market and concept Engineering Firms should act pro-actively and create own opportunities and that targeting the most essential stakeholders, municipalities and citizens, other potential customers will automatically follow. Innovation of the Engineering practice, how to work, will also help grasping RSC BOs. By discussing aspects that hinder successful RSC implementations through a simple Systems Engineering Framework that provides insight in the different stages of Engineering recommendations can be made. Conclusions are that RSC integration into projects needs to be made explicit from an early stage, time and budget need to be allocated for not directly billable activities such as pro-active project acquirement and that the inclusive character of RSC solutions require horizontal project team structures.

Together, these steps provide starting conditions for RSC services, but the actual Value Proposition (VP) is all-important. To have the best chance of succeeding, both practically and politically, within the Engineering Firm the VP should connect to existing service areas, and to have the best chance of succeeding in the marketplace it should be a single, integrated service requiring little change of behavior from the customer. In this case study the suggested RSC service package is split into three distinct but integrated services. As a top-down planning service the Engineering Firm can provide a RSC Framework through Physical Development Plans. These plans provide a Resilient framework based upon environmental, societal and technological layers. Through RSC Process Management the firm can act as Area Director, a central stakeholder connecting all parties involved and assessing the merit of bottom-up projects as related to the RSC Framework. Lastly, by identifying potentially strong RSC projects the company can offer RSC Entrepreneurial Projects, offering RSC area development to interested parties in a profitable way by spotting opportunities that have a high level of popular and political interest. These three services are closely connected to each other and can act independently, as well as in the form of a single integrated service. Of course, the VP requires a strong Revenue Model to actually capture the value. For most of the services the Revenue Model can take traditional forms, but it is worth mentioning that there is potential for innovation through a Bait Model combined with a Service Model, where the integration of the different services helps lock-in customers for the long term. This will help selling the RSC Process Management service that will not directly result in monetary value. Alternatively, it can be worth investigating a Realtor Model for this service, earning a percentage of actual added value from the customer.

Overall, all these aspects work together towards the Model for grasping RSC Business Opportunities. This model, the RSC definition, the RSC vision and sixteen strategic recommendations, some of which discussed here, form the concrete results of this research.

SAMENVATTING

Sinds kort wonen er voor het eerst meer mensen in stedelijke omgevingen dan erbuiten en alles wijst erop dat de verstedelijking alleen maar verder zal toenemen. Dit zorgt ervoor dat onze steden voor een aantal grote uitdagingen staan. Hoe blijven uitdijende stedelijke gebieden bijvoorbeeld leefbaar ondanks grote druk op omgevings- en infrastructurele systemen en hoe gaan zij om met duurzaamheidsvraagstukken, zoals 'peak-oil' en klimaatverandering? Hierbij moet het belang van een democratisch perspectief, dat zich richt op de behoeften van stadsbewoners en niet slechts op technische oplossingen, niet worden vergeten. Parallel aan deze vraagstukken trekt de Nederlandse overheid zich steeds verder terug uit de ruimtelijke ontwikkeling. Trends als afnemende budgeten en decentralisering en liberalisering zorgen ervoor dat de ontwikkeling van de leefomgeving steeds meer wordt gedicteerd door economische krachten en minder door gerichte overheid-strategieën. Een belangrijke vraag is hoe levensvatbare oplossingen voor stedelijke problematieken binnen deze context kunnen worden gerealiseerd. Dit is de vraag waar het Resilient Smart City (RSC) concept zich mee bezighoudt.

Dit onderzoek richt zich ten eerste op de vraag wat het RSC concept is en hoe het van toegevoegde waarde kan zijn voor stedelijke omgevingen. Doormiddel van een uitgebreide literatuur review is een RSC definitie opgesteld: ***De Resilient Smart City is een stad die haar bewoners bemachtigd om haar te helpen ontwikkelen op een efficiënte en duurzame wijze, doormiddel van Resiliency oplossingen***. Deze definitie is zo opgesteld dat hij afwijkt van traditionele Smart City (SC) definities. Hij is gericht op doelen en resultaten, en niet op specifieke middelen of technieken, en op de behoeften van eindgebruikers i.p.v. te technocratische oplossingen. De definitie ziet de stad als een altijd veranderende entiteit en is dus gebaseerd op veranderlijkheid en niet op een vast eindbeeld. Tot slot draait hij om een inclusief, integraal, gedachtegoed, Waar de SC vaak gebaseerd is op individuele stadssystemen. De keuze om een ander pad te kiezen dan dat van de SC is een bewuste, om weg te blijven bij deze definitie die in de loop der jaren zoveel verschillende betekenissen heeft gekregen dat hij sterk aan waarde heeft ingeleverd.

Om de implicaties en implementaties van het RSC concept te onderzoeken verschuift de focus van het onderzoek vervolgens richting de vraag hoe ingenieursbureaus (IB), als casestudy, zakelijke kansen kunnen grijpen d.m.v. het RSC concept en zo een sterke marktpositie kunnen veroveren en tegelijkertijd kunnen bijdragen aan een gezonde stadsontwikkeling. Om dit te onderzoeken zijn theoretisch onderzoek naar de RSC en bedrijfsstrategieën gecombineerd met een praktische casestudy. Het concept van Bedrijfsmodel Innovatie (BMI) is gebruikt als onderzoekskader. Door de innovatie van verschillende delen van het bedrijfsmodel te onderzoeken is gewerkt aan een strategie om marktkansen te benutten. De gebruikte methode is ad-hoc, kwalitatief en exploratief van aard, gebaseerd op desk research, gesprekken en discussies met belanghebbenden en de analyse van concrete, stedelijke ontwikkelingsprojecten.

De RSC visie vormt een stip aan de horizon inzake de mogelijkheden van het concept en gerelateerde diensten. De visie draait om grootschalige stadssystemen waar nodig, gebaseerd op Resiliency. Deze bieden een kader voor gedecentraliseerde stadssystemen waar mogelijk, gebaseerd op burgerparticipatie, onafhankelijkheid en organische ontwikkeling. Een uitgebreide stakeholder analyse op basis van de huidige situatie en veranderende rollen, toont aan hoe de markt het best kan worden benaderd met nieuwe RSC diensten. Resultaten tonen dat door nieuwheid van het concept het IB zeer proactief zal moeten handelen om zijn eigen markt te creëren. Daarnaast is het van belang de belangrijkste stakeholders, gemeentes en inwoners, gericht te benaderen aangezien zij het gedrag van de rest van de markt sturen. Ook de ingenieurspraktijk binnen het bureau zou baat hebben van innovatie rond RSC. Door vragen omtrent het functioneren van het bureau rond RSC aspecten te projecteren op een eenvoudig Systems Engineering kader, dat inzicht geeft in de verschillende fases van het ontwerpproces, kunnen aanbevelingen worden gedaan. Zo moeten RSC doelstellingen en implementaties reeds in een vroeg stadium expliciet worden gemaakt en moet tijd en budget worden vrijgemaakt voor zaken die niet direct door-berekenbaar zijn aan klanten, zoals het proactief werven van opdrachten. Tot slot vraagt de integrale aanpak om een horizontale organisatie van projectteams.

De bovengenoemde aspecten vormen een stevige basis voor RSC diensten, maar centraal staat de waarde propositie (WP). Door de WP aan te laten sluiten bij bestaande diensten van het IB is de kans van slagen intern het grootst. Extern is de kans van slagen het grootst als zo min mogelijk gedragsverandering van de klant wordt gevraagd, d.m.v. een eenduidige, geïntegreerde service. In het geval van deze casestudy betreft de service drie concrete diensten. Ten eerste het bieden van top-down planning d.m.v. Fysieke Ontwikkelingsplannen, die een Resilient stadskader bieden gebaseerd op veranderlijke lagen als de natuurlijke omgeving, en maatschappelijke en technologische ontwikkelingen. Via RSC procesmanagement kan het bureau acteren als gebiedsregisseur, de centrale partij die alle belanghebbenden verbind en de waarde van concrete projecten en relaties t.o.v. het RSC kader kan beoordelen. Tot slot kunnen ondernemende projecten worden ondernomen om RSC gebiedsontwikkeling te bieden aan geïnteresseerde partijen, door slim gebruik te maken van kansen die bestaande stedelijke problematieken bieden. Uiteraard vraagt de WP ook een sterk verdienmodel. Voor veel van de diensten kan dit model vrij traditioneel zijn, maar er liggen een aantal kansen tot innovatie. Zo kan de integratie van de verschillende diensten toegevoegde waarde bieden d.m.v. een combinatie van het lokaasmodel en het service-model, waarbij klanten voor lange termijn zijn verbonden aan het IB. Ook een makelaarsmodel, het verdienen van een percentage van de daadwerkelijke toegevoegde waarde, kan interessant zijn, met name voor RSC procesmanagement dat niet altijd direct zal resulteren in monetaire waarde.

Al deze aspecten werken samen om een model voor het grijpen van RSC zakelijke kansen te creëren, Dit model, de RSC definitie, de RSC visie en zestien strategische aanbevelingen, waarvan sommige hier beschreven zijn, vormen de concrete resultaten van het onderzoek.

ABSTRACT

Introduction

Due to an ever-increasing population and environmental issues contemporary Urban Areas are facing important challenges in the areas of livability, sustainability and citizen needs. The newly developed Resilient Smart City concept is interested in addressing exactly these issues. At the same time the Dutch government is increasingly taking a back seat role in spatial development, leaving room for initiative from commercial parties like Engineering Firms to play an pivotal role. When combined this implies there are strong Business Opportunities for Engineering Firms in the area of RSCs. This research is interested in exactly what it entails for Engineering Firms to grasp these opportunities.

Method

The research is largely made up out of two major papers. The first part consists of a literature review, exploring present literature on Smart Cities, Resilient Cities, Business Opportunities and the relationship between them. The second paper describes a case study on how Engineering Firms can grasp RSC Business Opportunities through a process of Business Model Innovation. This case study took the form of a qualitative and explorative research that uses a combination of desk research, internal and external discussions and explorative interviews and the analysis of case study projects to develop a model for grasping RSC Business Opportunities. Its overall cohesiveness is ensured by the development of a research framework based upon BMI, Business Strategy theory and the well-known Business Model Canvas.

Results

The results consist of the definition of the Resilient Smart City, a city that empowers its citizens to help it develop efficiently and sustainably through resiliency solutions, and a RSC vision that acts as a dot on the horizon for developing and marketing RSC services, that is based upon a resilient framework combined with decentralized, organic urban development. The research into BMI based upon this RSC Vision results in strategies and sixteen concrete recommendations on how to approach the marketplace, how to adapt Engineering Practice, what projects to work on and how to capture value through the offering of RSC services. Together these aspects form an integrated model for grasping RSC BOs for Engineering Firms, based upon the BM Canvas.

Abstract

1 INTRODUCTION

1.1 Problem Area and Context

The phrase Smart Cities has been in the center of attention in the field of Urban Development for quite some time, although It is not always exactly clear what is meant by it. The term can be very narrow, focusing on ICT solutions in an urban context, or very broad, covering a wide spectrum of Smart Services working in conjunction with each other towards a self-reliant and sustainable urbanism. In fact, the exact definition is such a point of discussion, it will be one of the main focal points of this research. For now it suffices to say that the Resilient Smart City, a more specific phrase defined in this research because of its stronger societal relevance after extensive research on the subject, is interested in empowering its inhabitants to help develop their cities in a sustainable, and efficient way through resiliency solutions.

The problem area is becoming ever more interesting due to its context. Recently a tipping point passed, and now more people are living in urban environments than outside of them, and this trend of urbanization is only projected to continue and strengthen. This situation provides our cities with a number of large challenges. For instance, how will the ever-growing cityscapes continue to be livable, despite huge pressure on environmental and infrastructural systems? Added to this, environmental issues, such as peak oil and climate change, and goals and regulations related to these issues are forcing societies to rethink the way cities will need to function in a sustainable fashion towards the future. And, just as importantly, how can these issues be faced in a democratic way, focusing not just on technocratic solutions but on the actual needs of city dwellers?

At the same time the Dutch government is taking an ever more back seat role in the spatial development of the Netherlands, especially at the local level. The trend of declining budgets, combined with liberalization, means that regional and urban development is increasingly dictated by economical forces, and less by government strategies and ideals. How then to realize viable solutions for the problems at hand? This is the question the Resilient Smart City Concept is interested in, and more specifically this research is interested in.

1.2 Problem Definition and Delineation

Because it is interested in the major problems facing our ever-growing cities, the Resilient Smart City is clearly an interesting and potentially important concept for present and future urban development. However, as we will become clear, up until now the Smart City concept is most often used as an analytical tool to rank cities on Smartness, as a Concept to build ICT solutions upon to sell or even as a container phrase to add to the exposure of whatever an author or authority is interested in.

The true implementation of the concept to cities is still in a very early stage, although many municipalities are interested in the idea. There can be several reasons why the implementation of the concept has been lacking up until now, and finding the exact reasons is another major question for this research. Beforehand, there are some clear indications. Firstly, not all stakeholders involved are sufficiently knowledgeable on the concept to add to its implementation. Secondly, the fact that the traditional Smart City Concept has so many different definitions and reasons for being makes it difficult for stakeholders to know what actions to undertake, even it they are knowledgeable on the subject. Lastly, it can be very hard for stakeholders like municipalities to implement Resilient Smart City solutions simply because it is not there core business. Often they lack the budget and manpower to actively implement relatively complex solutions.

This situation might sound very problematic, but in fact for the right stakeholder it can also be a strong opportunity. A stakeholder that is capable of filling the gaps in knowledge and capability in the field of Resilient Smart Cities can find itself presented with a huge Business Opportunity, provided of course that the stakeholder itself knows how to cope with the problem at hand. This is where the central problem for this research comes in. Within the wide scope of research possibilities related to the Resilient Smart City Concept this research is interested in the role a specific stakeholder, in this case an Engineering Firm, can play in the implementation of Resilient Smart City Solutions. The choice for an Engineering Firm as the stakeholder at hand was made for several reasons, including the fact that the Grontmij company was one of the main drivers behind this research, but the most important reason is the fact that Engineering Firms seem to be in a central position within the Urban Development marketplace to play an important role. Within the delineation of the RSC Business Opportunity for Engineering Firms there can still be many focal points. Like stated above the problem for limited RSC implementation can be related to the product or service itself, knowledge on the subject, etc.

However the hypothesis of this paper, based upon initial desk research and conversations with experts, is that the traditional Urban Development Business Plan, for lack of a better term, used by Engineering Firms, does not accommodate the needs of RSC solutions. Stated as a series of cascading problems, the delineation of this research can be depicted as follows:

Research Delineation: *Resilient Smart Cities -> Practical Relevance and Implementation of RSC -> RSC as a Business Opportunity for Engineering Firms -> Design and Innovation of the Business Model*

And stated as a single sentence the Research Problem reads as follows:

Research Problem: *The Resilient Smart City could play an important role in the efficient and sustainable development of cities as well as empowering citizens in this process and it could offer a strong Business Opportunity for Engineering Firms, but its implementation is still marginal, partly due to the difficulties the implementation of the concept provides for Engineering Firms.*

1.3 Research Questions

To investigate this problem a main research question is needed, as well as several sub-questions to support it. Finding the right research question for this case was an iterative process, where the true problem at hand only became clear after initial desk research and explorative conversations with experts where held. As such the search for the right research question became part of the research itself. From the beginning it was clear that the research was about the role an Engineering Firm can play in the implementation of RSC solutions, and as such the Business Opportunity it presented to such a firm. After initial research it became clear that the role of the chosen Business Model can be an important part of this question. Therefore the main Research Question of this Research is:

Research Question: *What does it entail for an Engineering Firm to grasp Resilient Smart City Business Opportunities, and what, if any, changes in its Business Model does this imply?*

To be able to answer this question a number of sub-questions need to be answered, starting with questions defining the Resilient Smart City and its relationship to the Urban Development Market:

Sub-Question (1): *What is a working definition of the Resilient Smart City concept?*
Sub-Question (2): *Why is it relevant to implement Resilient Smart City solutions?*
Sub-Question (3)*:* *What is holding back RSC implementations at present?*

After this, the questions will shift towards Business Opportunities related to the RSC concept:

Sub-Question (4)*:* *How can Engineering Firms grasp Resilient Smart City Business Opportunities?*
Sub-Question (5): *What, if any, adaptations could/should Engineering Firms make to their Business Models to best help implement RSC solutions?*

1.4 Research Design and Framework

The research is structured along the lines of two main papers. The first paper presents a literature study on the Resilient Smart City concept, basic theory on Business Opportunities and the combination of the two. As such it provides the main theoretical framework of the research. The second paper describes a case-study on how Engineering Firms can grasp Business Opportunities through the Resilient Smart City concept. As such it describes the practical model of the research. Actual research methods used for the purposes of the papers are described within the papers themselves, as well as abstracts, introductions,

references, etc. Because of this structure, some duplications of information are to be expected but this is offset by the advantage that both papers can be read in their own right.

Together the two papers form a research framework that is structured along the two central aspects of the research question. Firstly, what is the Resilient Smart City concept, and secondly, how can Business Opportunities be grasped through the concept. The overall framework including sub-aspects is described in Figure 1 Research Framework.

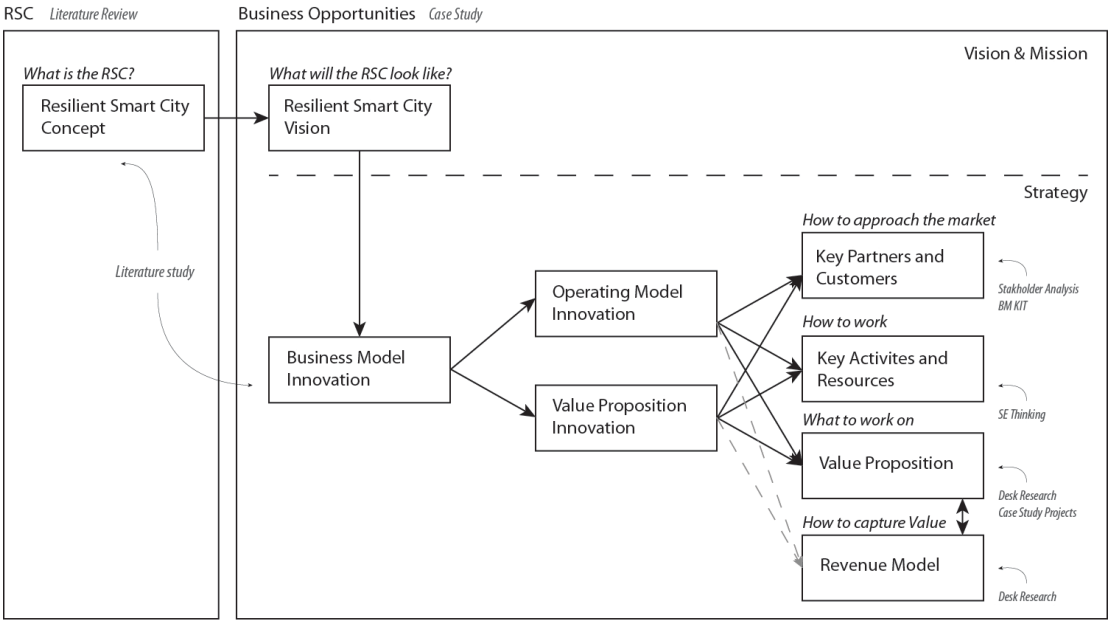

Figure 1 Research Framework

1.5 Expected Results

The expected results of this Research are to start with answers to the main question as well as all the sub-questions. For some of the sub-questions the answers will be more implicit, needed to answer the main question or consequent sub-questions, while other questions will be answered through explicit products, such as a working definition of the Resilient Smart City for Sub-Question 1.

Clearly defined results will be provided by a set of Business Model Innovations for being able to optimally participate and compete in the Resilient Smart City marketplace.

Overall, the goal is to come to recommendations for Grontmij as a case-study for Engineering Firms as to what to do to be able to help implement Resilient Smart City solutions and in doing so grasp Business Opportunities. And secondly, through this, to gain broader insight in the possibilities of practical implementations of the RSC Concept on the one hand, the role of Business Model Innovation on the other hand, and the combination of both aspects specifically.

2 GLOSSARY

Adaptability:
The ability to adapt to new conditions. An aspect of resiliency.

Business Model (BM):
A plan for the successful operation of a business, identifying sources of revenue, the intended customer base, products, and details of financing.

Business Model Innovation (BMI):
The innovation of the BM to make it better suitable to bring a (new) service or product successfully to market.

Business Opportunity (BO):
Ongoing opportunity to generate income through a service or product.

Citizen Empowerment:
Added democratic and economic value offered to citizens by involving them in their own housing and environmental needs and services.

Decentralization:
The act of moving (aspects of a) larger body away from a central administrative center towards the end-user.

Engineering Firm (EF):
A company made up of professional engineers and consultants that offers consulting and technical services to a wide range of customers.

Persistence:
The tendency of a social-ecological system to change to remain within a stable domain. An aspect of resiliency.

Resiliency:
The capacity to recover quickly from difficulties and return to a stable state. Aspects include persistence, adaptability and transformability.

Resilient City (RC):
A city where urban systems are based are based upon resiliency

Resilient Smart City (RSC):
A city that empowers it citizens to help it develop efficiently and sustainably through resiliency solutions.

Revenue Model:
The model through which a certain Business Strategy captures Value.

Smart City (SC):
Unclear definition that is often adapted to suit to authors needs. It often revolves around ICT solutions within urban systems.

Sustainability:
The ability to be maintained at a certain state or level. Often used in the context of conserving an ecological balance by avoiding the depletion of natural resources.

Transformability:
The capacity to create new stable domain. An aspect of resiliency.

Urban Development (UD):
The development or improvement of an urban area by building.

3 A LITERATURE REVIEW ON THE RESILIENT SMART CITY CONCEPT AND BUSINESS OPPORTUNITIES

A Literature Review on the Resilient Smart City Concept and Business Opportunities

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ABSTRACT

Due to increasing population among other causes contemporary Urban Areas face many challenges in questions of livability, sustainability and citizen needs. A concept that is interested in handling these challenges is that of the Resilient Smart City (RSC). This literature review strives to answer the question what exactly the Resilient Smart City concept is and how it can be valuable by researching literature on Smart Cities, Resilient Cities and related subjects. Furthermore it researches how the concept is related to Business Opportunities and how Business Opportunities are discovered and created in general. Together these aspects lead to a theory on how Business Opportunities could be grasped through the RSC concept, serving both the goals of potential RSC service providers, grasping Business Opportunities, and that of Municipalities and Citizens, livable, sustainable, empowering and highly competitive and self-reliant Urban Areas. Conclusions include that a Resilient Smart City is a city that empowers its citizens to help it develop Efficiently and Sustainably, through Resiliency solutions and that Business Opportunities can be grasped through Business Model Innovation.

Keywords: Smart City, Resilient City, Business Opportunities

1 INTRODUCTION

The phrase Smart Cities (SC) has been in the center of attention in the field of Urban Development for quite some time, although It is not always exactly clear what is meant by it. The term can be very narrow, focusing on ICT solutions in an urban context, or very broad, covering a wide spectrum of Smart Services working in conjunction with each other towards a self-reliant and sustainable urbanism. The problem area is becoming ever more interesting due to its context. Recently a tipping point passed, and now more people are living in urban environments than outside of them, and this trend of urbanization is only projected to continue and strengthen. This situation provides our cities with a number of large challenges. For instance, how will the ever-growing cityscapes continue to be livable, despite huge pressure on environmental and infrastructural systems? Added to this, environmental issues, such as peak oil and climate change, and goals and regulations related to these issues

are forcing societies to rethink the way cities will need to function in a sustainable fashion towards the future. And, just as importantly, how can these issues be faced in a democratic way, focusing not just on technocratic solutions but on the actual needs of city dwellers? At the same time the Dutch government is taking an ever more back seat role in the spatial development of the Netherlands, especially at the local level. The trend of declining budgets, combined with liberalization, means that regional and urban development is increasingly dictated by economical forces, and less by government strategies and ideals. How then to realize viable solutions for the problems at hand? This is the question the Resilient Smart City Concept is interested in.

This paper will firstly provide a literature review on Resilient Smart Cities (RSC), a more specific concept than the general Smart Cities phrase that was developed partly through this review as a more suitable concept to meet the urban challenges at hand. The goal of the review is to create a firm foundation for advancing knowledge on the subject. It was written as part of a larger research on Resilient Smart Cities as a Business Opportunity (BO). For this research it will facilitate theory development and help define the field of research the paper will focus on. It will do so, by presenting an overview of the research already conducted within the targeted field, looking at key concepts, goals and methods. In the process it will help answer some of the researches main research questions, notably defining a Resilient Smart City concept. Secondly, it will review theory on Business Opportunities (BO) in general and as related to the RSC. The importance of linking RSC to Business Opportunities is twofold. Firstly, in a practical and societal sense this focus will help drag the SC and RSC concepts out of the abstract theoretical field towards beneficial implementations. Secondly, in a scientific sense, by doing so it will help increase knowledge on the subject by choosing a less standard research approach.

The term Smart Cities is well known in the field of Construction Management & Engineering (CME). As we will see its definition can be very narrow, focusing on ICT solutions for urban areas, or very broad, covering a wide spectrum of smart services working together as a strategic concept in city competition. Like (Alkandari & Alshekhly 2012) and (Neirotti et al. 2014) rightly state, until now there is no unique definition for Smart Cities. Most researchers define the Smart City from their needs or perspectives. To give just an indication on the wide range of topics involved one recent publication provides a useful overview that is summarized in Table 1.

	Domains	Main Objectives of articles
Hard Domains	Energy Grids	Automated Grids that facilitate the delivery of energy and exchange of information through ICT, with the goal of reducing costs and increasing reliability of energy supply systems.
	Public Lighting, Natural Resources and water management	Managing Public Lighting and Natural Resources and exploiting Natural Resources and water.
	Waste Management	Applying innovations to effectively manage waste produced by households, businesses and services.
	Environment	Using technology to protect and better utilize natural recourses, with the ultimate goal to improve sustainability.
	Transport, Mobility and Logistics	Optimizing transport and Mobility in Urban Areas through all sorts of innovations.
	Office and Residential Buildings	Adopting sustainable building technologies with the goal to create housing and working conditions that utilize less recourses.
	Healthcare	Using ICT and remote assistance to prevent and diagnose diseases
	Public Security	ICT information that is used by for instance police and fire departments to protect citizens and their goods.
Soft Domains	Education and Culture	Creating more opportunities for students and teachers through the use of ICT
	Social Inclusion and welfare	Making tools available to improve learning and participatory opportunities for citizens.
	Public administration and (e) Government	Enhancing e-services offered by governments.
	Economy	Facilitating innovation and entrepreneurship related to Smart City Concepts.

Table 1 Domains of a Smart City (Neirotti et al. 2014)

The fact that it has so many different interpretations and definitions also makes it a bit of an empty concept. If it can be everything, it also has very little relevance as a concept. This situation is understandable, due to the fact that the concept is used for many different reasons and in many different contexts. One of the prime goals of this review is to gain understanding in the reasoning behind the different Smart City approaches.

To understand the relevance of the RSC concept, more than just a definition is required. Primarily, the true importance of the concept needs to become clear. Why is the RSC discussed and/or implemented. Does it offer better living conditions to inhabitants? Does it help in environmental issues? Or is it just a matter of being slightly more cost efficient? It is also important to understand when and where the concept was implemented and researched, and for what reasons. Therefore the review will also focus on the different contexts and goals that where involved in papers on the subject. Of course, here it is of importance to see if these aspects match with the intended contexts and goals of this paper or not, and why. For much the same reason, this literature review will be looking at the research methods that were used in conducting research on RSC. The different aspects related to the RSC concept discussed by the various authors that will be discussed in this literature review are grouped thematically, based upon the roles the RSC plays in the various articles involved. Researches that combine both RSC aspects and Business Opportunities will receive specific attention and the concept of Business Opportunities in general will also be

discussed. The overall goal of this strategy is to construct a theory on the relationship between the RSC concept and grasping BOs.

It is important to note that the term Resilient Smart City is a term almost exclusively used within the confines of the Grontmij company. Like stated, the term Smart Cities is a wide spread one, often used in research. The term Resilient City however, is often used in a different context. For our goals both terms are of prime importance and will be covered in the review. The scope of literature discussed is as wide as possible, and thus not limited to any particular subset of magazines. The aim is to review the most recent publications, but when older publications are still relevant they will not be excluded.

This paper is divided in two main chapters. The first will focus on different conceptual aspects that are covered in existing literature on Smart Cities and Resiliency, concluding in a paragraph that defines a new working definition of the Resilient Smart City based upon commonly returning properties. The second chapter will focus on literature on Business Opportunities as related to Smart Cities and in general. Together the two chapter contribute to a concluding chapter on potential Business Opportunities as related to Resilient Smart Cities.

2 THE RESILIENT SMART CITY

2.1 Smart Cities as a way to more efficiently manage the City

To understand the emergence of the Smart City concept it is important to understand in what sort of context it sprouted. One of the most important aspects that is mentioned in most of the publications that are conscious about placing the SC in a wider context is the changing size and position of cities. For some time now more than half the worlds population is living in an urban area, and it is projected that this shift towards urban living will only grow in the coming decades. Inevitably, the large-scale congregation of people in cities has strong implications on their livability and manageability. (Chourabi et al. 2011) (Harrison & Donnelly 2011) This managerial aspect is key in understanding the way the SC concept is often defined. Often the city is seen as a system of different networks, ranging from its physical infrastructure of roads, sewage, energy-grids, etc. to networks of governance, education, etc. and of course the network of the cities inhabitants. Overall, the goal of making the city smart is to make it run more efficiently, cleanly, etc. The range of networks is quite extensive among the authors who have written about the subject, and different aspects are sometimes present and sometimes absent. (Singh 2014) for instance names a large number of aspects, both 'hard' and 'soft'; Smart Healthcare, Smart Building, Smart Mobility, Smart Infrastructure, Smart Technology, Smart Energy, Smart Citizen, Smart Governance and Smart Education, while the earlier publication (Centre of Regional Science Vienna UT 2007) uses a shorter list of aspects: Smart Economy, Smart Mobility, Smart Environment, Smart People, Smart Living and Smart Governance. Variations of these sorts of lists can be found all around. Most often the different sub-aspects of the Smart City are then further defined by examples or sub-aspects of their own. Table 2 Elaboration of Smart City

aspects shows an example of how the sub-aspects can be elaborated. It is by no means exhaustive but gives an indication o the reasoning being used by many authors.

Sector	Aspects
Smart Business	Integrated ICT Sustainability Smart Economy
Smart Living	Innovative & experimenting Sustainable living
Smart Education	Stability Research Supportive
Smart Citizen/Community	Smart, proactive people Education & Research Culturally vibrant & happy
Smart Government	e-government Easy access Transparent
Smart Infrastructure	Connectivity Integrated services
Smart Utility	Energy efficiency Reduced emissions Smart meters
Smart Mobility	Smart Transport Electric Vehicles Dynamic Traffic Control
Smart Environment	Green Pollution Control Climate change adaption

Table 2 Elaboration of Smart City aspects (Smart Directions n.d.)

The main idea of defining these aspects of the Smart City is that making a city smart involves making the different networks smarter. This can be on the level of separate networks, but there have also been attempts to argue that the networks should be seen in unison and placed in a framework. A quite basic example of such a framework can exist of the three main aspects involved in the Smart City, Technology, People and Institutions, overlapping in the right, Smart, way to achieve a smart City (Nam & Pardo 2011). A slightly more complex framework states that Technology, Organization and Policy are reinforced by Governance, Communities, Economy, Built Infrastructure and the Natural Environment to form the building blocks of a Smart City Initiative. (Chourabi et al. 2011) It will be of no surprise that definitions of Smart Cities that use this line of reasoning often include aspects like measuring the different levels of smartness of the different networks, or counting the number of networks a city performs well on.

2.2 Smart Cities and ICT

An aspect that takes center stage very often in discussions about Smart Cities is that of the role ICT plays. In fact, the word Smart can almost be replaced by ICT in many publications. For instance, (Schaffers et al. 2012) writes that technology is currently promoting unprecedented changes in urban areas. Internet-based infrastructures of cities comprise a diversity of services in healthcare, energy, education, environmental management, transportation and mobility, etc. These services are increasingly enabled by broadband infrastructures, wireless sensor networks, internet-based applications, open data and open platforms. According to these authors our cities are quickly becoming like computers in open air.

Importantly, it has to be stated that the over-emphasis on ICT when related to Smart Cities partly needs to be explained due to the emergence of, and strong belief in, ICT in the 1990s, the same period the Smart City concept emerged. More critical authors state that ICT solutions can certainly be, and often are, a part of the Smart City, but they should serve as a tool, and not a goal in itself. (Caragliu et al. 2011a) The ICT based vision is often closely linked to the managerial, network based, vision described in Smart Cities as a way to more efficiently manage the City. Here, technology serves as a way to make one or several of the networks smarter, i.e., more efficient. Ideally, ICT should also function to coordinate and integrate the different networks, so that smartness and efficiency is achieved by creating a symbiosis between the different networks. (Batty et al. 2012) In this way, the possible value of ICT services could actually be quite interesting, albeit still no more than a tool.

A strong critical note in this line of thinking, however, is that although many promises were made, technological and ICT implementations have often been small demonstrators that lack scalability. Among other reasons, it often remains unclear for city leaders to see the true, applicable new value of ICT solutions. (Cosgrave et al. 2013)

Many other publications however focus on specific technologies. Mostly, these technologies focus on a single smart aspect. The authors are mostly interested in the specific technology, sometimes as a vehicle to achieve a broader Smart City, sometimes just focusing on the technology itself, using the Smart City term as an umbrella term. Examples of this include, but are certainly not limited to, (Hancke et al. 2013), who focuses on the state of the art of sensing technology for all sorts of different city networks, and (Bach et al. 2010) and (Chen 2010) who focus on Smart Energy through Smart Energy Grids.

2.3 Smart Cities, City Branding and City Quality

The phrase Smart City is also often used as a City Branding tool, or more fundamentally, being a Smart City allows cities to compete. Along with the growing number of people living in cities, globalization and trade liberalization have made both citizens and companies flexible in their settlement behavior. Cities of course prefer to attract the best and brightest and for that reason aim to position themselves, among other things, as Smart Cities. (Centre of Regional Science Vienna UT 2007) Importantly, this implies some interesting aspects.

Although at first sight the branding aspect might be seen as superficial, it does focus on the perceived needs of people. While still using the abstract list of smart networks, like exemplified in Smart Cities as a way to more efficiently manage the City, the suggestion is that Smart aspects make the city more attractive for potential inhabitants. This means that here the Smart City concept evolves into a vehicle of better living and working standards, instead of just a way to manage the city more efficiently, although it is not always clear how sub-aspects actually achieve these better settlement qualities. Along with this shift in goals of the Smart City, there are also new sub-aspects that define the Smart City, or that become more important than in the more managerial point of view. For instance, here more functional aspects, like the presence of Higher Education (Winters 2011), attractive (technological) companies, but also a simply pleasant housing environment become aspects of the Smart City. (Caragliu et al. 2011a) (Leydesdorff & Deakin 2011). In the same line of reasoning there is also often an emphasis on the presence of smart, creative people, particularly entrepreneurs, for a status as smart city. Also, thanks to their presence there are often physical manifestations of smartness within the city, like creative districts and sustainable, knowledge-based urban spaces. (Kourtit & Nijkamp 2012a)

This different focus serves a very important role, namely pulling the Smart City concept out of an all to technocratic environment of efficient networks, and into the world of the actual end-user of the city, its inhabitants. Also, they involve the actual physical presence of the city. Interestingly, many of the articles interested in these aspects are not particularly interested in defining the Smart City, they simply accept that a Smart City includes aspects like higher education, good living facilities, entrepreneurs and front-running companies.

2.4 Smart and Resilient Cities

The previous paragraphs all more or less illustrated how the Smart City concept is often introduced as a tool or point of view to more efficiently manage the growing and changing city, whether or not with a central role for ICT and technology, or to better the cities present livability and competitiveness. There is another context that plays a central role in the development of the Smart City, and that is the position of the city in the debate about sustainability, resource scarcity, peak-oil, etc. A truly Smart City has to be conscious of these worldwide questions, especially taking into account the fact that ever more people are living in cities. (Hancke et al. 2013) Relatively few authors explicitly state these questions as starting point of the Smart City, but most acknowledge their importance and involve them somehow through one of their sub-aspects of the Smart City. An active project like Amsterdam Smart City explicitly states as its goal to save energy, now and in the future. (Amsterdam Smart CIty 2011) Likewise, (Bătăgan 2011) makes the argument that Smart Cities should focus on sustainable development, and that sustainable development involves the technological changes, and quality of live, but also the limits of the environment.

Not all researches related to Smart Cities are actively interested in this environmental aspect, although it seems clear they should be, there is another phrase that is very much so, and is at least sideways connected to the Smart City: the Resilient City. A Smart City should also be a Resilient City. To understand what a Resilient City is, it is important to first understand what resiliency in general means in the realm of social-ecological systems. Resilience thinking focuses on three aspects, being persistence, adaptability and transformability. Persistence is about the tendency of a social-ecological system to change to remain within a stable domain. Adaptability is the capacity of a system to adjust to changing external drivers and internal processes to remain within the stable domain. Transformability is the capacity to create new stable domain. (Folke et al. 2010) In other words, a resilient system can persist despite obstacles, it can adapt to overcome obstacles or it can transform to overcome obstacles. Translating this idea to cities, cities can be conceptualized as complex, adaptive systems. Botch physical and social processes can be understood as interactions across these networks. People, activities, institutions, recourses and processes interact to create the unknowable ordering of the city. Strategies can help to direct the development of these relationships towards the goal of managing and preparing for change and uncertainty. Aspects involved are adaptive plans, redundancy, modularity, and learning from pervious crises. (Desouza & Flanery 2013)

Resiliency is, and will become ever more, important for our cities. Two major drivers behind this fact are climate change, and the threat of so called peak-oil. (Chapman 2012) To start with the latter, rapidly tightening constraints on oil and the associated climbing prices (Murray & King 2012)will have a profound effect on the functioning of cities. Future cities will not be able to function on oil based economy, transportation and energy production, like they do at present. Likewise, climate change has profound effects on the functioning of the future city, both through the need to cut CO_2 production and the possible, physical affects on cities, such as flooding, warming, etc. Especially the combination of both factors demands resiliency from cities. (Antrobus 2011) provides an interesting view that helps understand resilient aspects in practical implication better, by confronting modernization with resilience. For instance, he describes that by thinking of green spaces in cities as carriers of resiliency, their (economic) value for the city becomes much wider than just that of a luxury. Green spaces help in all sorts of systems, be it in climate change, biodiversity, retaining water, etc. Likewise, by looking at low carbon energy production not just from a viewpoint of low CO_2 emission, but also from the concept of decentralized energy production, the city becomes less reliant on external flows of energy, and therefore more resilient. In the process local energy production can also help empower communities. These are just two examples of concrete resiliency aspects in cities. One very important point that is made here is that a shift towards resilient thinking also requires insight in the long-term beneficial effects of resiliency. Often initial investments are larger than traditional solutions, but the total cost of ownership can be lower.

Positively, (Cork 2010) indicates that policy makers are increasingly focusing on resilience, at least in his case study in Australia. Urban aspects that are considered, or should be considered in the resilience debate according to this author are energy and water use efficiency, carbon-neutrality, eco-efficiency, green productivity and the satisfaction of human cultural and other social needs. This last aspect adds yet another level to the Smart and Resiliency discussion, i.e. a focus on human needs, such as a sense of place in cities.

2.4.1 Global Problems, Local Solutions

Climate change, peak oil, etc. are considered global problems, but they are felt locally. Resilient Cities also strive to offer solutions at a local level. For this resilience thinking, as described above, needs to be combined with community-based adaptions. When talking about community-based solutions, we are not just talking about the scale and location of the solution, but also about the involvement and knowledge offered to local stakeholders. By implementing participatory systems, actively involving local communities, they can deal more effectively with sudden change, risks and long-term stresses. At the same time, this process can also help create social capital, trust, and collective competence (Hordijk & Baud 2011). Here the Resilient City also touches upon social aspects, like empowering communities in their own environments, a topic the next paragraph, Smart Cities and the needs of citizens, will build further upon.

2.5 Smart Cities and the needs of citizens

Next to aspects like efficient city management, city branding and resiliency in the face of climatic and ecological issues there is of course one major component that a Resilient Smart City should focus on: the wants and needs of citizens of the city. Some aspects that relate to this were already mentioned by different authors, implicitly and explicitly. Of course citizens will benefit from a city that is managed efficiently and therefore remains livable, and many of the aspects named in Smart Cities, City Branding and City Quality focus on the needs of inhabitants. A city that effectively deals with climate issues is a city that provides a safe environment to live, etc. However, there are several authors that strongly feel that the Smart City concept is often used purely from a neo-liberal roadmap, focusing on efficiency and profit, and less so on the needs of its citizens. (Allwinkle & Cruickshank 2011) A comparable criticism is provided by (Deakin & Al Waer 2011) , who state that Smart City developments often have more to do with the corporate needs of marketing campaigns, than the social intelligence required for cities to actually be smart.

There are explicit needs that a Smart and Resilient City should cater to that were not extensively covered up until now. Some basic needs include sustainable local economies, anchored by key competences and recourses in the local economic tissue. This economy should be resilient and inclusive. Spatial exclusion and energy poverty should be excluded and cities should have a holistic approach to their green environment and offer attractive open public spaces. Especially the first examples are closely related to the power and position of the inhabitants, like we have seen before in the discussion on decentralized

energy production. An important aspect for citizens is to have a large measure of control over their own energy production, energy usage and savings, recycling, etc., and the costs and potential income related to these issues. Social innovation can offer possibilities in this realm and so can the planning and design of the city. (European Union 2011) The aspect of citizen involvement in the innovation, and co-creation, of urban areas is stressed by more authors to be an integral quality that a Smart City should offer. Methods to achieve citizen involvement are often based upon open innovation and collaboration between local governments and citizens. (Komninos et al. 2013) By creating opportunities for different types of learning and cooperation, citizen-driven resilience responses can be nurtured. (Desouza & Flanery 2013) (Deakin & Al Waer 2011)

Overall, many of the authors discussed on this subject agree that to be or become a Smart City, the actual involvement of citizens is very important. Firstly in the co-creation of ideas, open innovation, etc., and secondly by empowering citizens to be able to help tackle global issues, like energy production, climate change, recycling, etc. for themselves, and also reaping the benefits from their efforts. Citizen involvement provides new insights and a bottom-up surge of energy that makes true innovation possible and grounded in communities. This aspect however never seems to enter common definitions of the Smart City.

2.5.1 Maslow's Hierarchy of Needs

Without delving too deep into psychology, on a more theoretical level the needs of citizens can be equalized to the needs of people in general, as depicted by Maslow's hierarchy of needs, depicted in Figure 2 Maslow's Hierarchy of Needs.

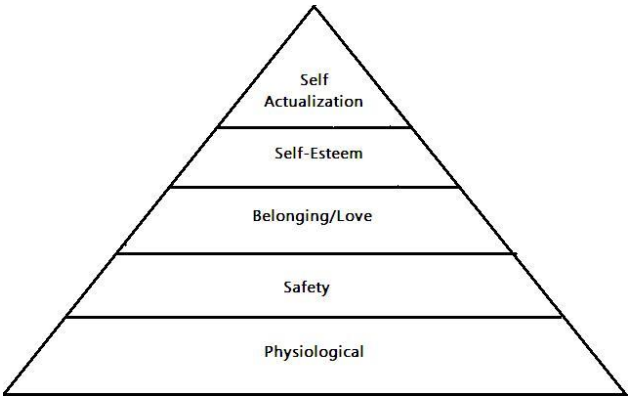

Figure 2 Maslow's Hierarchy of Needs (Maslow 1969)

The pyramid expresses human needs, playing the most fundamental levels at the bottom and the need for self-actualization at the top. The bottom level is the most basic and concerned with physical needs, the second level is concerned with safety, the third with interpersonal relationships, the fourth with self-esteem and self-respect, while the highest level is related to the realization of ones potential. (Maslow 1969)

Resilient Smart Cities are concerned with the bottom levels through their physical state as a city. A RSC offers shelter, air, water, light, food, etc., just as any other well functioning city would. The same is true for safety aspects. Where the RSC could differ from traditional cities is in the higher regions of the pyramid. Through aspects like community and citizen involvement and empowerment higher level needs of citizens also come into scope if the right implementations are chosen. Interestingly, Maslow in his later years added another layer, that of self-transcendence. This is the need to also giving to a higher goal than oneself. An aspect that could be closely related in helping in global issues, such as the environmental issues discussed before.(Maslow 1969)

This look at human needs is an aspect not often, if ever, considered in relationship to Smart Cities. It could however offer a vehicle to more easily pinpoint the benefit Resilient Smart City Solutions could have for inhabitants, and is therefore worthy of further future elaboration.

2.6 Smart Cities and Scientific Research

Most research on Resilient Smart Cities does not focus on market opportunities, as will be discussed in the following chapter. The question then becomes what sort of actual research was done on Smart Cities, and with what goal.

The first common aspect that is quite striking is that many articles have a very explorative function. Like this literature review itself, they are often interested in exploring what a Smart City is, what aspects are involved, etc. Towards this goal, they use several methods, most often a short literature review, a summary of, or an introduction to, more specific articles, a disquisition on the state of the art of Smart Cities, etc. In any case, they are mostly involved with the study of existing literature. This is true for many of the articles already discussed, like not exclusively (Hancke et al. 2013), (Kourtit & Nijkamp 2012b), (Batty et al. 2012) and (Chourabi et al. 2012). A closely related sort of research to the explorative articles above is that of the case study. Several articles look at actual, practical implications of Smart and/or Resilient City aspects in different cities and regions. These articles include, but again are not limited to (Komninos et al. 2013), (Bakici et al. 2013), (Antrobus 2011) and (Alawadhi et al. 2012). This last article conducted its case study through the use of semi-structured interviews with government officials in four North-American cities.

More empirical research was also conducted on the subject of Smart Cities. A quite specific research, was provided by (Centre of Regional Science Vienna UT 2007). The institute created an application, that can be viewed online, to rank different medium-sized European cities on their level of Smartness, based upon standardization and transformation of the various sub-aspects of the Smart City that were defined. Where this research was interested in ranking different cities, (Neirotti et al. 2014) used a regression analysis in order to understand the relationship between various geographical, urban, demographical, human capital, environmental and technology-related variables and the dependent CI variable. The CI has been defined as the ratio of Smart City domains covered by a city compared to the

total of potential domains. Results showed that there is no unique, global definition of the Smart City, and that local evolution patterns of Smart Cities depend greatly on local context factors.

An especially interesting research, because if focuses on the Smart City concept through a market based approach, used Quality Function Deployment (QFD) and specifically the House of Quality to develop a technology Research & Design roadmap. (Lee et al. 2013) Quality Function Deployment was used to establish interconnections between services and devices and between devices and technologies. Market preferences were part of this QFD method. Concretely, QFD helped define different stages in the roadmap, including demand identification and also helped highlight which services and devices best matched market based service demands. This research was conducted in the form of a Case Study on South-Korean Smart City initiatives.

2.7 Defining the Resilient Smart City

Overall, while most of the articles on Resilient Smart Cities had an highly prescriptive character, some more specific research methods where also implemented, serving different goals. There is definitely room to approve upon the scientific knowledge on the Smart City concept, especially once one delves deeper than defining the phrase or describing how it is adopted through case studies. However, to be able to conduct further research it is of course of prime importance to have a working definition on the subject at hand. As was rightly stated by (Alkandari & Alshekhly 2012), different authors, companies and institutions define the phrase according to their own interests and needs. Because this is the way the Smart City concept came into being there is no strict definition, there have even been articles that explicitly argue this point. (Neirotti et al. 2014) Therefore, coming up with a working definition is also the only way to use the concept in a practical setting. One has to come up with his own definition to be able to work with it. This is however not to say that there are no similarities to be found in the reasoning behind the different approaches and definitions within the field, and therefore aspects that are more essential than others. By studying the different ways the Smart & Resilient City was analyzed it is possible to at least capture the core aspects that should always be part of any definition used for further studies. Table 3 groups together a number of definitions that were presented by authors based upon their different points of view.

Definition	Point of View	Source
A city well performing in a forward-looking way in economy, people, governance, mobility, environment, and living, built on the smart combination of endowments and activities of self-decisive, independent and aware citizens.	Efficiency Sectorial Approach	(Centre of Regional Science Vienna UT 2007)
A city 'connecting the physical infrastructure, the IT infrastructure, the social infrastructure, and the business infrastructure to leverage the collective intelligence of the city	ICT	(Harrison et al. 2010)
A Smart City uses a forward looking development approach, considering issues such as awareness, flexibility, transformability, synergy, self-decisiveness and strategic behavior. The term is not used in a holistic way describing a city with certain attributes, but is used for various aspects which range from Smart City as an IT-district to a Smart City regarding the education (or smartness) of its inhabitants.	City Branding Sectorial Approach	(Centre of Regional Science Vienna UT 2007)
Resilience in terms of cities usually refers to the ability to absorb, adapt and respond to changes in an urban system. Resilience also shares much with other key contemporary urban goals, such as sustainability, governance and economic development	Resiliency	(Antrobus 2011)

Table 3 Definitions of Smart Cities

Firstly, it seems more than clear the Smart City concept has a lot to do with the more efficient management of the city, and specifically the different systems within the city. This aspect has to be understood through the ever-growing pressure on, and importance of, the city due to the increase in population, in absolute and relative terms, in cities. Growth offers new challenges for all sorts of systems, like energy, water, infrastructure, housing, etc. Making a City Smart means handling these new challenges in the most efficient way possible. Often ICT solutions are part of this increase in efficiency and Smartness, however it has to be stated that the over-emphasis on this information technology driven approach has to be understood through the growing importance of ICT in the same period as the emergence of the Smart City concept (Caragliu et al. 2011b) and the fact that many publications on the subject where driven and financed by ICT related companies like Siemens and IBM. In principle, ICT solutions are a tool, and not a goal in themselves, but obviously in the 21st century they can be very useful and powerful tools, so they should also not be dismissed. In the same line of reasoning, many different authors have tried to define the exact subsystems of the city they believe are part of a Smart City. Defining the subsystems can be a tool to gain insight, but the simple fact that almost every author comes to a different set of systems and aspects indicates that there is no absolute truth to be found. The only true observation seems that a Smart City covers as many of the cities systems as possible, if not all. Again, by handling it is meant that the systems run as efficiently as possible.

This brings us to a second observation. What is the actual goal behind the efficient management of the city? Of course, firstly it is to stop the city from malfunctioning and to keep it an attractive place to live. However, many publications also indicate that sustainability issues are most certainly part of the goals of a Smart City. Some articles do so explicitly, but many if not most do so by defining subsystems that are closely related to these issues, and by the way they state that they can be Smart. (Neirotti et al. 2014) In fact, the efficient management of the city and sustainability aspects are closely related. Obviously, in the long run our cities can not continue to function properly if they do not handle questions like energy production, CO2 emission, water detainment, etc. in a future oriented fashion. This is also where the phrase Resiliency comes in. Resilience is simply one of the most effective ways to make sure cities can handle all sorts of issues that are thrown towards them, now and in the future, by being adaptable. This is true for durability questions, but just as well for other issues, like the economical and physical development of the city. Resiliency is effectively just one tool to make cities more future proof, and therefore Smart, but it is a tool that is mentioned explicitly and implicitly by many publications as very important because it is the most effective and sustainable.

As a result of being run efficiently and sustainably Smart Cities are cities that are more attractive to live and work in. For this reason, the fact that a 'green' image is very attractive for both politicians and companies and the fact that the same is true for an innovative, front-running image, the Smart City concept is also often used from a City-branding point of view. (Centre of Regional Science Vienna UT 2007) However, City-branding should not be a goal of making a city Smart in itself, it should be a result. An attractive, efficient and future oriented city will have a strong market position and therefore be able to attract wanted inhabitants, institutions and companies. Even more importantly, apart from branding and competition, the city should offer the best possible condition for its users, the citizens. This is its reason for being. Therefore, a Smart City initiative should be actively aware of this aspect, something that is often forgotten by more technocratic points of view that are often related to Smart City thinking. Surprisingly, this is true for many of the publications on the subject. Like stated before, offering strong living conditions to inhabitants is often implicitly the result of a efficient, adaptable and sustainable city. There are also more explicit needs that a Smart City can and should cater to. These issues are related to the empowerment of citizens in their own future. Both in the 'soft' sense, involving democratic principles, co-creation, open innovation, etc., but also in the 'hard' sense, offering citizens and communities the possibility to for instance produce and sell their own energy, recycling, etc. (Komninos et al. 2013) (Desouza & Flanery 2013)

Especially this 'hard' aspect is also closely related back to Resiliency issues. A city that produces its own energy, is more future proof and less reliant on outside threats, etc. This aspect is especially interesting, because it is by no means omnipresent in publications on the Smart City.

Together, these three main aspects, especially the combination of the three, should be part of any Smart & Resilient City definition/project/initiative. Table 4 pulls these aspects together, to form a working definition of the Smart & Resilient City. The definition is inclusive; this is to say it talks about the city as a symbiosis of all its systems. Therefore it is not interested in naming specific sub-systems, a Resilient Smart City includes all aspects involved. In a comparable manner, the definition is not interested in specific tools, but in outcomes. This is not to say that some tools might take a large role in achieving the goals. For instance, many cutting edge implementations will definitely require ICT solutions. Lastly, both sub-systems and tools are named in the table, not because of their leading role, but to provide examples of possible areas of interest.

Definition		**A Resilient Smart City is a city that empowers its citizens to help it develop Efficiently and Sustainably, through Resiliency solutions.**
		Aspects
Efficiently	How the city functions and remains livable right now.	Cost-effective, symbiosis of systems, infrastructures according to state of the art technologies, etc. Resiliency through adaptability can help maintain efficiency in the long term.
Sustainably	How the city handles future oriented questions, and remains livable in the long term.	Energy neutral, CO2 neutral, self-sufficient in water management, heating, waste and recycling, etc. Resiliency through adaptability can play a large role
Empowering	How the city offers explicit value to its inhabitants.	Involving citizens in their own futures. For instance by giving communities the opportunity to produce their own energy and reek the benefits. This specific example has the added benefit of including Resiliency aspects.
Resiliency Solutions	Future oriented tools towards achieving the goals above	Persistence, Adaptability and Transformability

Table 4 A working definition of the Smart & Resilient City

What sets the Resilient Smart City concept apart from traditional Smart City definitions are among other aspects the following qualities:

- It is aimed at goals and results, not at specific tools or technologies. This is not to say that tools like ICT cannot play an important role.
- It includes end-user needs and steers away from technocratic solutions.
- It believes the city is an ever-evolving entity, so it does not believe in fixed solutions.
- It involves an inclusive way of thinking. The sectorial approach often present in Smart City thinking as found in for instance Table 1 and Table 2 is abandoned in favor of an integral approach.

3 BUSINESS OPPORTUNITIES

Now a clear definition of the Resilient Smart City has been defined it is time to shift the focus of this literature review towards business opportunities. Firstly, what has been written specifically on the relationship between Smart Cities and Business Opportunities, and secondly, what is basic theory on business opportunities in general?

3.1 Literature on Smart Cities as a Business Opportunity

An aspect that several authors recognize is that whatever the exact definition of the Smart City is, if it exists it can also be monetized and if it is seen as a Business Opportunity. (Singh 2014) goes as far as to state that Smart Cities offer a 1.5 trillion dollar market opportunity and (Department for Business Innovation and Skills 2013) suggests comparable high numbers for the United Kingdom marketplace. The latter article states that over 80% of global Gross Domestic Products is earned in cities and recognizes five Smart City market niches that companies could enter: Smart Energy management, Smart Water management, Smart Transport management, Waste management and Assisted living A well known engineering firm that is actively involved in trying to define these sorts of Smart City market opportunities is ARUP. The former article goes somewhat further and adds actual strategies to enter the market successfully. Four main models are presented through which companies can engage with city authorities Build Own Operate (BOO), Build Operate Transfer (BOT), Build Operate Manage (BOM) and Open Business Model (OBM). The Open Business Model offers the largest possibility for Smart City innovations by companies, because here city planners offer a large amount of freedom to organizations to build infrastructures and services. Likewise, four roles that Smart City participants can play are defined: Integrators, Network Service Providers, Pure-play Product Vendors and Managed Service Providers.

Although this article offers some interesting insights and possible strategies, sadly when presenting the participant roles it becomes clear it is purely interested in ICT based offerings. For many of the same reasons as described in the paragraph Smart Cities and ICT this focus is true for many, if not most, authors interested in Smart City market opportunities. In this line of though, demand from local governments, and similar conglomerations like universities and company towns for certain hardware and software categories related to Smart Cites, is expected to drive incremental opportunities for ICT suppliers in the foreseeable future. (Bélissent 2010) Despite the strong focus on ICT, some of the advices given in this article towards capturing business opportunities could also be interesting for other Smart City service providers. For instance, it is stress that vendors should partner with urban leaders and provide active guidance, not only on the technological solutions and services, but also on the business models and delivery options that will help ensure the viability of Smart City Projects.

The lack of literature on Smart City business opportunities not entirely focused on ICT services and service providers seems to indicate a limited interest in the subject within the scientific community up until know. Of course, more general literature on the seizing of business opportunities in new and technical markets is commonplace. Basic concepts like building a vision, mission and strategy based upon a unique value proposition, segmenting and targeting a viable market niche, defining a marketing strategy, etc. (Byers, T. H., Dorf, R. C., Nelson 2011)will be applicable in some form or another, but more detailed research on this specific topic will certainly provide new insights.

3.2 Business Opportunities in general

According to (Byers, T. H., Dorf, R. C., Nelson 2011) a good Business Opportunity is one that has the potential to create significant value for the customer. Whether or not these opportunities exist independently of entrepreneurs or that they can be enacted is a matter of discussion. (Alvarez & Barney 2007) In practice however it seems there is a combination of both aspects. Objective elements of opportunities can be found in the world, but it are subjective motivations, behavior and activities of the entrepreneur or company who realizes them (Cloodt 2013).

Therefore, to grasp these Opportunities a strategy is required. In general a Business Strategy consists of a Vision, a Mission and A Strategy. The vision describes the long term goal of a company, the mission its present reason for being and the strategy the way to achieve the vision and mission. (Cloodt 2013)

Figure 3 Business Strategy (Cloodt 2013)

Overall, successfully grasping Business Opportunities is a question of setting oneself apart from the competition by ***doing something different***, that creates ***true value*** for the customer, and is effectively ***brought to the market***.

3.3 The Business Model

To create a successful Business Strategy that is able to do exactly this a company or entrepreneur requires a fitting Business Model. In short the BM defines how an organization creates, delivers and captures value. (Al-Debei & Avison 2010) It can be depicted in many ways, often the famous Osterwalder Canvas depicted in Figure 4 is used, but overall it consists of two essential elements, the Value Proposition (VP) and the Operating Model (OM).

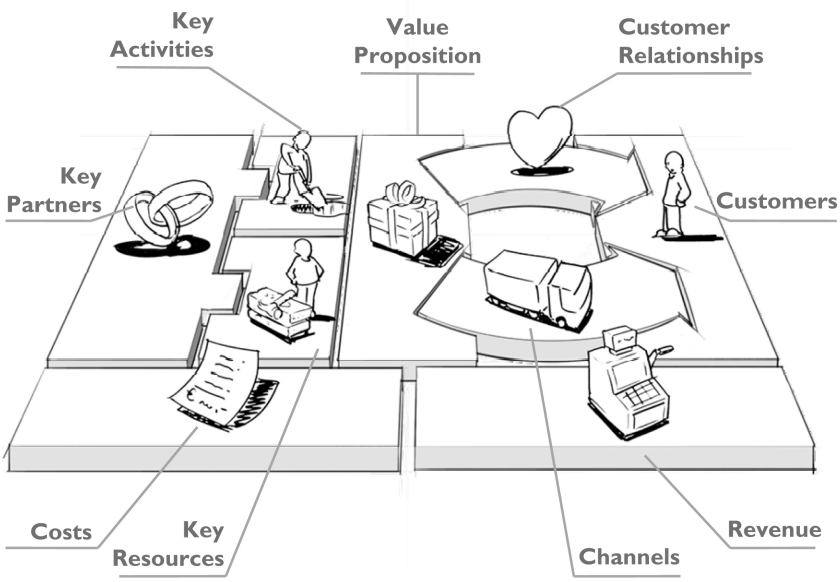

Figure 4 Osterwalder Business Model Canvas (Source material: (Osterwalder 2010))

Each of these consists of three sub-segments (Lindgardt et al. 2009) that work together towards the Business Model, as depicted in Figure 5

The Value Proposition consists of:

- Target Segments: Which customers are served? Which of their needs are addressed?
- Product of Service Offering: What is offered to the customers to satisfy their needs?
- Revenue Model: How is the Offering Compensated?

The Operation Model consists of:

- Value Chain: How is the company configured to deliver on customer demand?
- Cost Model: How are assets and costs configured to deliver the VP profitably?
- Organization: How are employees deployed towards a competitive advantage?

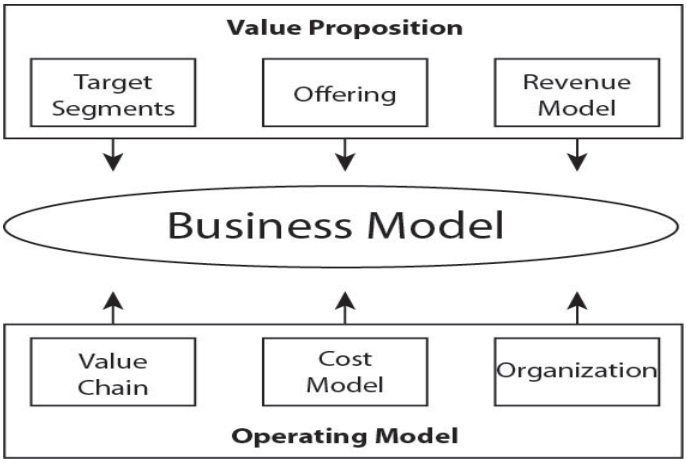

Figure 5 Component of the Business Model (Source material (Lindgardt et al. 2009))

3.4 Business Model Innovation

One way for an existing company to more successfully grasp business opportunities when implementing a new product or service is Business Model Innovation. In general, Business Model Innovation can be very useful. For instance, it can help companies, such as Engineering Firms, to break out of intense competition. More importantly for the case of RSC, it can help address disruptions such as regulatory or technological shifts that demand fundamentally new competitive approaches. (Lindgardt et al. 2009) As discussed, this is exactly what is happening with the introduction of RSC solutions to the marketplace. BMI goes beyond simply offering a new product. It takes place when at least two of the components, preferably in both the Value Proposition and the Operation Model, of the Business Model are reinvented to deliver value in a new way. Only then can it help set a company apart in the market.

BMI is often more challenging than product or process innovation, but research shows that it also delivers superior returns. The premium can be more than four times greater than that enjoyed by product or process innovators, and BMI also delivers more sustainable returns in the long run. Even after ten years successful BM Innovators tend to outperform their competitors. (Lindgardt et al. 2009)

Alternative sources such as (Amit & Zott 2012) perceive the same advantages for BMI while choosing slightly different areas of innovation, such as:

- Content of an Activity System: What is the activity of the company?
- Structure of an Activity System: How are the activities linked and in what order?
- Governance of an Activity System: Who performs the actions.

Clearly, these aspects are closely linked to the aspects in Figure 5 Content -> Offering

- Structure -> Value Chain
- Governance -> Organization

3.5 RSC and Business Opportunities

This chapter has been a basic introduction on the theory of Business Opportunities and the role the Business Model plays in grasping these opportunities. It has become clear that to grasp Business Opportunities a successful Business Model is needed, and that to achieve a successful BM for an existing organization introducing a new product or service Business Model Innovation can be very useful. This chapter has purposefully been kept quite concise and general and has only been interested in Business Opportunity theory in general and Business Opportunity literature as related to Resilient Smart Cities. The goal of this research is not to innovate Business Opportunity theory, but to implement it in research towards Resilient Smart Cities Business Opportunities.

4 DISCUSSION AND CONCLUSION

It has become clear that there is a multitude in attitudes, interests and definitions in research involving the Smart & Resilient City subject. At first glance it seems that the phrase can mean almost anything because it is mostly used to suit each publishers specific needs, but there is certainly a logic that binds the different points of view through common underlying goals and aspects that at first glance where not always explicit. This has resulted in the definition in Table 4 that is both very broad, by not digging into specific tools and solutions but focusing on main goals a Resilient Smart City should strive for, and at the same time quite specific, because if only includes those aspects that where present on a meta-level in many discussed articles. Overall this definition states that a Resilient Smart City is a city that is able to develop efficiently and sustainably, not in the smallest part through empowering its inhabitants, through Resiliency solutions. Although not revolutionary this definition has added something to the discourse on RSC. It has to be stated that as is the case with Smart City related definitions it is not a perfect, definitive definition but it is suitable for this specific context.

There is a risk that by choosing a definition that bypasses direct references to aspects that are often central to existing definitions, such as the prime importance of ICT implementations and a focus on involved Smart City subsystems, it will not be recognized as a definition for the Smart City as it is often seen. Importantly, these aspects can most definitely be part of the concept, but they are seen as tools, not as goals as such. Hopefully, a somewhat differing definition will lead to new insights when it is applied in future research. By testing it in such a way the validity of the definition will become clear.

This theoretical framework will serve as one of the starting points for research on possible business opportunities in the field of RSC for engineering firms, specifically through Business Model Innovation, but it could serve the same purpose for a multitude of new researches, seeing as though it has become clear there is much room for improvement in this scientific field, especially for any research reaching further than literature studies, summaries and case studies of state of the art techniques. One of the major advantages of looking at business opportunities is that by its very definition it will need to pull the RSC concept out of

its theoretical world and into the world of practical, spatial applications. This is something that would seem quite important for something as physical as a city, but that is not often the focus in the theoretical scientific discourse. In a striking paradox, the goal of this interest in practical implications will actually serve as a vehicle to further the scientific knowledge on RSC, because it will delve into areas that as of present have been largely ignored. By looking at practical implementations of an abstract theory, it will hopefully also become clearer what the concept actually is. As such, the definition provided by this theoretical framework will most likely change or be expanded upon as soon as future research has been done.

REFERENCES

Al-Debei, M.M. & Avison, D., 2010. Developing a unified framework of the business model concept. *European Journal of Information Systems*, 19, pp.359–376.

Alawadhi, S. et al., 2012. Building understanding of smart city initiatives. In *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*. pp. 40–53.

Alkandari, A. & Alshekhly, I.F.T., 2012. Smart Cities : Survey. *Journal of Advanced Computer Science and Technology Research*, 2(2), pp.79–90.

Allwinkle, S. & Cruickshank, P., 2011. Creating Smart-er Cities: An Overview. *Journal of Urban Technology*, 18, pp.1–16.

Alvarez, S.A. & Barney, J.B., 2007. Discovery and creation: alternative theories of entrepreneurial action. *Strategic Entrepreneurship Journal*, 1, pp.11–26. Available at: http://doi.wiley.com/10.1002/sej.4.

Amit, R. & Zott, C., 2012. Creating Value Through Business Model Innovation. *MIT Sloan Management Review*. Available at: http://sloanreview.mit.edu/article/creating-value-through-business-model-innovation/.

Amsterdam Smart CIty, 2011. Amsterdam Smart City. *URENIO Research Unit*. Available at: http://www.urenio.org/2011/04/20/amsterdam-smart-city-smart-stories-2011/.

Andersson, S., 2015. The Urban as a Resilient System of Processes. *Topos - The International Review of Landscape Architecture and Urban Design*, pp.22–29.

Antrobus, D., 2011. Smart green cities: from modernization to resilience? *Urban Research & Practice*, 4, pp.207–214.

Bach, B., Wilhelmer, D. & Palensky, P., 2010. Smart buildings, smart cities and governing innovation in the new millennium. In *IEEE International Conference on Industrial Informatics (INDIN)*. pp. 8–14.

References

Bakici, T., Almirall, E. & Wareham, J., 2013. A Smart City Initiative: The Case of Barcelona. *Journal of the Knowledge Economy*, 4(January 2012), pp.135–148.

Bătăgan, L., 2011. Smart Cities and Sustainability Models. *Revista de Informatică Economică*, 15, pp.80–87. Available at: http://revistaie.ase.ro/content/59/07 - Batagan.pdf.

Batty, M. et al., 2012. Smart cities of the future. *European Physical Journal: Special Topics*, 214, pp.481–518.

Bélissent, J., 2010. Getting clever about smart cities: new opportunities require new business models. *Forrester Research, inc*, p.33. Available at: http://groups.open.org.nz/groups/ninja-talk/files/f/19710-2010-11-04T092134Z/getting_clever_about_smart_cities_new_opportunities.pdf.

Board of Innovation, 2015. index @ www.boardofinnovation.com. Available at: http://www.boardofinnovation.com/ [Accessed March 20, 2015].

Byers, T. H., Dorf, R. C., Nelson, a. J., 2011. *Technology Venture from Idea to Enterprise*,

Caragliu, A., Del Bo, C. & Nijkamp, P., 2011. Smart Cities in Europe. *Journal of Urban Technology*, 18, pp.65–82.

Centre of Regional Science Vienna UT, 2007. *Smart cities Ranking of European medium-sized cities*, Available at: http://linkinghub.elsevier.com/retrieve/pii/S026427519800050X.

Chapman, R., 2012. Resilient Cities: Responding to Peak Oil and Climate Change. *Journal of Urban Design*, 17, pp.301–303.

Chen, T., 2010. Smart grids, smart cities need better networks. *IEEE Network*, 24, pp.2–3.

Chourabi, H. et al., 2011. Understanding smart cities: An integrative framework. In *Proceedings of the Annual Hawaii International Conference on System Sciences*. pp. 2289–2297.

Chourabi, H. et al., 2012. Understanding Smart Cities: An Integrative Framework. *2012 45th Hawaii International Conference on System Sciences*, pp.2289–2297. Available at: http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=6149291 [Accessed July 10, 2014].

Cloodt, M., 2013. Technology Entrepreneurship. , (November).

Cork, S., 2010. Resilient Cities. In *Resilience and Transformation: Preparing Australia for Uncertain Futures*. pp. 5–22.

Cosgrave, E., Arbuthnot, K. & Tryfonas, T., 2013. Living labs, innovation districts and information marketplaces: A systems approach for smart cities. In *Procedia Computer Science*. pp. 668–677.

References

Deakin, M. & Al Waer, H., 2011. From intelligent to smart cities. *Intelligent Buildings International*, 3, pp.133–139.

Department for Business Innovation and Skills, 2013. *The Smart City Market: Opportunities for the UK*,

Desouza, K.C. & Flanery, T.H., 2013. Designing, planning, and managing resilient cities: A conceptual framework. *Cities*, 35, pp.89–99.

Drevel, J., Visser, W. & Jonge, M. de., 2012. Zelf verantwoordelijk voor kavel en omgeving. *Land+Water*, (6). Available at: http://www.grontmij.nl/MediaCenter/Nieuwsarchief/Documents/Zelf verantwoordelijk voor kavel en omgeving.pdf.

European Union, R.P., 2011. *Cities of Tomorrow. Challenges, visions, ways Forward*, Available at: http://discovery.ucl.ac.uk/111079/.

Folke, C. et al., 2010. Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society*, 15.

Grontmij, 2015a. Diensten @ www.grontmij.nl. Available at: http://www.grontmij.nl/diensten/Pages/Diensten.aspx [Accessed March 20, 2015].

Grontmij, 2015b. RuimtevoorRuimte. Available at: http://www.grontmij.nl/Projecten/Pages/RuimtevoorRuimte.aspx.

Grontmij, 2015c. Thuis in de stad , thuis in stedelijke gebiedsontwikkeling.

Hahn, H.A., 2013. The conundrum of verification and validation of social science-based models. *Procedia Computer Science*, 16, pp.878–887. Available at: http://dx.doi.org/10.1016/j.procs.2013.01.092.

Hancke, G.P., de Silva, B. de C. & Hancke, G.P., 2013. The role of advanced sensing in smart cities. *Sensors (Switzerland)*, 13, pp.393–425.

Harrison, C. et al., 2010. Foundations for Smarter Cities. *IBM Journal of Research and Development*, 54, pp.1–16.

Harrison, C. & Donnelly, I., 2011. A theory of smart cities. In *Proceedings of the 55th Annual Meeting of the ISSS*. pp. 1–15. Available at: http://journals.isss.org/index.php/proceedings55th/article/view/1703.

Hordijk, M. & Baud, I., 2011. Resilient Cities. *Media*, pp.111–121. Available at: http://www.springerlink.com/index/10.1007/978-94-007-0785-6.

Komninos, N., Pallot, M. & Schaffers, H., 2013. Special Issue on Smart Cities and the Future Internet in Europe. *Journal of the Knowledge Economy*, 4, pp.119–134.

References

Kopp, F., 2015. A Literature Study on the Resilient Smart City Concept and Business Opportunities.

Kourtit, K. & Nijkamp, P., 2012. Smart cities in the innovation age. *Innovation: The European Journal of Social Science Research*, 25, pp.93–95.

Lee, J.H., Phaal, R. & Lee, S.H., 2013. An integrated service-device-technology roadmap for smart city development. *Technological Forecasting and Social Change*, 80, pp.286–306.

Leydesdorff, L. & Deakin, M., 2011. The Triple-Helix Model of Smart Cities: A Neo-Evolutionary Perspective. *Journal of Urban Technology*, 18, pp.53–63.

Lindgardt, Z. et al., 2009. Business Model Innovation: When the Game Gets Tough, Change the Game. *Boston Consulting Group*, (December), p.9.

Maslow, A.H., 1969. The farther reaches of human nature. *Journal of Transpersonal Psychology*, 1(1), pp.1–9.

Murray, J. & King, D., 2012. Climate policy: Oil's tipping point has passed. *Nature*, 481, pp.433–435.

Nam, T. & Pardo, T.A., 2011. Conceptualizing smart city with dimensions of technology, people, and institutions. In *Proceedings of the 12th Annual International Digital Government Research Conference on Digital Government Innovation in Challenging Times - dg.o '11*. p. 282. Available at: http://dl.acm.org/citation.cfm?id=2037556.2037602\nhttp://dl.acm.org/citation.cfm?id=2072069.2072100\nhttp://dl.acm.org/citation.cfm?doid=2037556.2037602.

Neirotti, P. et al., 2014. Current trends in smart city initiatives: Some stylised facts. *Cities*, 38, pp.25–36.

Nicolaas Participaties, 2015. www.nicolaasparticipaties.nl. Available at: http://www.nicolaasparticipaties.nl/ [Accessed May 19, 2015].

Oberdorf, J., 2012. *Private housing within reach*.

Platform 31, 2003. Rol-gemeente-in-stedelijke-vernieuwing-sterk-veranderd @ kennisbank.platform31.nl. Available at: http://kennisbank.platform31.nl/pages/10284/Nieuws/Rol-gemeente-in-stedelijke-vernieuwing-sterk-veranderd.html [Accessed March 15, 2015].

References

Rijksoverheid, 2015. woningcorporaties @ www.rijksoverheid.nl. Available at: http://www.rijksoverheid.nl/onderwerpen/woningcorporaties [Accessed March 20, 2015].

Schaffers, H., Ratti, C. & Komninos, N., 2012. Special issue on smart applications for smart cities - new approaches to innovation: Guest editors' introduction. *Journal of Theoretical and Applied Electronic Commerce Research*, 7.

Singh, S., 2014. Smart Cities - A 1.5 Trillion dollar Market Opportunity. Available at: http://www.forbes.com/sites/sarwantsingh/2014/06/19/smart-cities-a-1-5-trillion-market-opportunity/.

Smart Directions, Smart Cities Reference Diagram. Available at: www.smartdirections.info/cities [Accessed February 12, 2015].

Thomas, G., 2011. A Typology for the Case Study in Social Science Following a Review of Definition, Discourse, and Structure. *Qualitative Inquiry*, 17(6), pp.511–521.

Winters, J. V., 2011. Why are smart cities growing? who moves and who stays. *Journal of Regional Science*, 51, pp.253–270.

References

4 THE RESILIENT SMART CITY CONCEPT AS A BUSINESS OPPORTUNITY FOR ENGINEERING FIRMS

The Resilient Smart City Concept as a Business Opportunity for Engineering Firms.

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ABSTRACT

Urban Areas are continuously growing and therefore facing ever-larger pressure on livability, environmental issues and sustainability among other areas. The Resilient Smart City concept was introduced as a strategy to face these issues by making cities efficient and sustainable through resiliency solutions while empowering its citizens. This paper researches the feasibility and potential profitability of practical RSC implementations through a case study on RSC Business Opportunities for Engineering Firms. It does so by using the concept of Business Model Innovation as the basis for its research structure. It discusses what a RSC vision could look like, how Engineering Firms should approach the Urban Development Market with the concept, how they should adapt their Engineering Practice and what types of projects they should work on. Along the way present business limitations and pitfalls are discussed and new strategies and recommendations are defined. Together, these aspects congregate in a model that helps offering true value to municipalities and their citizens by offering a different and better service than the competition. This service is based upon a RSC vision and includes a top-down RSC framework, bottom-up RSC services and RSC process management that connect the two. Added to this a strategy is developed to successfully bring it to market based upon a stakeholder analysis, adapt engineering practice and capture the added value. Overall, all indications are that an Entrepreneurial Mindset and a pro-active attitude are of prime importance to capture value in this new marketplace. The total strategy, an adaptation of the traditional Business Model Canvas, will help Engineering Firms to grasp Business Opportunities.

Keywords: Smart City, Resilient City, Resilient Smart City, Business Opportunities, Business Model Innovation, Entrepreneurship

1 INTRODUCTION

1.1 Problem Area and Context

Recently a tipping point passed, and now more people are living in urban environments than outside of them, and this trend of urbanization is only projected to continue and strengthen. This situation provides our cities with a number of large challenges. For instance, how will

the ever-growing cityscapes continue to be livable, despite huge pressure on environmental and infrastructural systems? (Chourabi et al. 2011) Added to this, environmental issues, such as peak oil and climate change, and goals and regulations related to these issues are forcing societies to rethink the way cities will need to function in a sustainable fashion towards the future. (Chapman 2012) And, just as importantly, how can these issues be faced in a democratic way, focusing not just on technocratic solutions but on the actual needs of city dwellers? (Komninos et al. 2013) (Desouza & Flanery 2013) (Deakin & Al Waer 2011)At the same time the Dutch government is taking an ever more back seat role in the spatial development of the Netherlands, especially at the local level. The trend of declining budgets, combined with liberalization, means that regional and urban development is increasingly dictated by economical forces, and less by government strategies and ideals. How then to realize viable solutions for the problems at hand? These are questions the recently introduced Resilient Smart City (RSC) concept is interested in. The RSC is an elaboration and adaptation of the well known phrase Smart Cities (SC). Where the SC concept is extremely fluid and can be very narrow, focusing on ICT solutions in an urban context, or very broad, covering a wide spectrum of Smart Services working in conjunction with each other towards a self-reliant and sustainable urbanism. (Neirotti et al. 2014), the RSC is defined as a city that empowers its citizens to help it develop Efficiently and Sustainably through Resiliency solutions. This definition was created trough an extensive literature review on the subject, (Kopp 2015).

1.2 Problem Definition and Research Question

Because it is interested in the major problems facing our ever-growing cities, the RSC is an interesting and potentially important concept for present and future urban development. However the true implementation of the concept to cities is still in a very early stage, although many municipalities are interested in the idea. There can be several reasons why the implementation of the concept has been lacking up until now, and finding the exact reasons is a major question for this research. Beforehand, there are some clear indications. Firstly initial conversations in the field indicate that not all stakeholders involved are sufficiently knowledgeable on the concept to add to its implementation. Secondly, the fact that the traditional SC Concept has so many different definitions and reasons for being makes it difficult for stakeholders to know what actions to undertake, even it they are knowledgeable on the subject (Neirotti et al. 2014). Lastly, it can be very hard for stakeholders like municipalities to implement RSC solutions simply because it is not there core business (Rijksoverheid 2015a). Often they lack the budget and manpower to actively implement relatively complex solutions. This situation might sound very problematic, but in fact for the right stakeholder it can also be a strong opportunity. A stakeholder that is capable of filling the gaps in knowledge and capability in the field of RSC can find itself presented with a huge Business Opportunity (BO), provided of course that the stakeholder itself knows how to cope with the problem at hand. This is where the central problem for this research comes in. Within the wide scope of research possibilities related to the RSC

concept this research is interested in the role a specific stakeholder, in this case an Engineering Firm, can play in the implementation of RSC Solutions. Engineering Firms seem to be in a central position within the Urban Development marketplace to play an important role. They have contacts and the capacity to advise all stakeholders involved on RSC services and implementations, and the willingness to do so if it presents a viable BO. However the hypothesis of this paper, based upon initial desk research and conversations with experts, is that the traditional Urban Development Business Plan, for lack of a better term, used by Engineering Firms, does not accommodate the needs of grasping RSC Business Opportunities. Therefore, the research problem for this paper can be stated as follows:

The Resilient Smart City could play an important role in the efficient and sustainable development of cities as well as empowering citizens in this process, but its implementation is still marginal, partly due to the difficulties the implementation of the concept provides for Engineering Firms.

And the related research question reads:

What does it entail for an Engineering Firm to grasp Resilient Smart City Business Opportunities, and what, if any, changes in its Business Model does this imply?

1.3 Related Research and Relevance

As mentioned, the paper that is closely related to this research, (Kopp 2015), extensively explored the SC concept, the concepts behind research on this subject and specifically its relationship to Business Opportunities. The same paper also indicated that to grasp BOs, especially in a new, disruptive marketplace like that of RSC, Business Model Innovation can be a powerful tool. By not only adapting the product or service that is brought to market, but also the way it is brought to market and the way the company functions internally the chance of successful implementation is increased manyfold. (Amit & Zott 2012) At a scientific level researching RSC as a BO is relevant, because it helps draw the RSC out of the world of definition building and best practice case studies, where it presently resides. This is partly also the reason for choosing the phrase Resilient Smart Cites, instead of the standard Smart City term. The choice of phrasing not only indicates a fundamentally different starting point for the definition, but also the goal to tackle the subject in a new way. The RSC, as it was defined places the citizens needs in the center of urban projects by striving to empower them, and at the same time, in no small part by doing this, it helps developing the city in a sustainable and efficient manner through resiliency solutions. This means the concept helps in some of the most important questions facing present-day cities: how to deal with major environmental issues; how to keep cities livable when they grow to extreme sizes, or alternatively shrink; how to involve and empower modern citizens in the processes so they can reach their own goals and reek the benefits and at the same time help realize solutions the shrinking government can or will not; etc.

1.4 Research Hypothesis as related to the Research Design

This research is based upon the hypothesis that the RSC concept can be very important for future Urban Development because it helps keeping urban areas livable now and in the future through efficiency and sustainability solutions, as well as offering democratic and financial value to inhabitants through citizen empowerment, and that its lacking implementation is partly due to a lack of stakeholders capable of facilitating it. Therefore there would be a strong BO for Engineering Firms in the field of RSC if they implement a suitable Business Model (BM). The paper will research what a suitable RSC BM would look like through Business Model Innovation (BMI) of three major parts of the BM - Key Partners and Customers, Key Activities and Resources and the Value Proposition - based upon a RSC Vision. Overall, the goal is to come to recommendations for the Engineering Firm Grontmij as a case-study for Engineering Firms as to what to do to be able to help implement Resilient Smart City solutions and in doing so grasp Business Opportunities. And secondly, through this, to gain broader insight in the possibilities of practical implementations of the RSC Concept on the one hand, the role of Business Model Innovation on the other hand, and the combination of both aspects specifically.

The following chapter will introduce the methodology used to investigate potential BMI. Chapter three will outline the results of this method and chapter 4 will include the main conclusions and discussions.

2 METHOD

The method used to conduct this research is a qualitative and explorative one. It was developed continuously during the research to support the needs of the main research problem and questions. Partially this way of working was consciously developed to not be overly limited in research on such an explorative subject by strict methodology, but partially it was also a consequence of the relative obscurity of the subject within the research environment itself. During early phases of the research it became clear that there was no strong basis for a traditionally structured (quantitative) research within the research environment of Engineering Firms and the Urban Development Marketplace when combined with a new RSC definition and an emphasis on BO, that would lead to a satisfactory content based outcome. This is by no means to say there is no theoretical basis, structure or verification, doing thins right, and validation, doing the right thing (Hahn 2013), present, as this chapter will outline.

2.1 Theoretical framework and Data Collection

2.1.1 Literature Review

The closely related paper A Literature Review on the Resilient Smart City concept and Business Opportunities provided a large part of the theoretical framework of this research. Here the definition of the RSC was established through an extensive review of relevant scientific literature on the subject and its relationship to Business Opportunities was

discussed. As such it acts as a starting point for this paper and it also forms a part of the verification and validation on concepts discussed.

2.1.2 Case Study

As a whole this research was conducted as a case study at Grontmij Nederland, specifically within the division of Gebiedsadvies. A case study is an intensive analysis of an individual unit stressing development factors in relation to context. Case studies can be descriptive or explanatory. The explanatory case study is used to explore causation in order to find underling principles. Put another way 'Case studies are analyses of persons, events, decisions, periods, projects, policies, institutions, or other systems that are studied holistically by one or more methods. The case that is the subject of the inquiry will be an instance of a class of phenomena that provides an analytical frame — an object — within which the study is conducted and which the case illuminates and explicates'. (Thomas 2011) This stresses that the case that is researched should be representative of a more general phenomenon, and that results should be able to be generalized. In this case this is true for Grontmij as an example for Engineering Firms, but also for instance for RSC Business Opportunities for more general disruptive BOs.

2.1.3 Explorative Interviews

As part of the case study many informal discussions and explorative interviews were held within Grontmij. This mostly took the form of casual day to day discussions, but also of more formal meetings. Discussions took place with general staff, experts in the field and interested parties. These discussions acted both as inspiration for formal desk research on new insights and as verification and validation on established theories.

2.1.4 Grontmij Projects

A second main source of input within the case study was formed by participation in and analysis of projects conducted within Grontmij and related to the subject of RSC and BOs. A number of specific projects and their relevance can be found in Appendix 4 Verification and Validation Projects. These projects act as a form of inspiration for formal desk research on new insights and more importantly as a mode of verification and validation. By analyzing the projects and their relationship towards RSC strategies suggested they can prove or disprove the ability, willingness, value, etc. of working a certain way within the Grontmij company. Desk Research

Lastly, the Theoretical Framework and Case Study were supported by additional Desk Research on specific subjects where required by the model.

2.2 Business Model Innovation as a Research Model

Overall, successfully grasping Business Opportunities is a question of setting oneself apart from the competition by doing something different that creates true value for the customer, and is effectively brought to the market. (Cloodt 2013) (Byers, T. H., Dorf, R. C., Nelson 2011) (Alvarez & Barney 2007). Furthermore, Business Model Innovation is a prime strategy to achieve this goal, especially for new, disruptive services. (Lindgardt et al. 2009) The RSC concept will entail disruptive services because many of its implementations will require a re-thinking of the present way of urban planning and development and services involved. These services are not simply a small adaption of existing ones, but offer something new to the marketplace Therefore, this research was designed to reflect the process of Business Model Innovation as the central framework for a Research Model.

2.2.1 Business Strategy Theory and The Business Model Canvas as a Research Framework

In general a Business Strategy is built up out of a Vision, a Mission and an operating Strategy. The vision and mission indicate why a company does what it does and the Strategy how it operates.

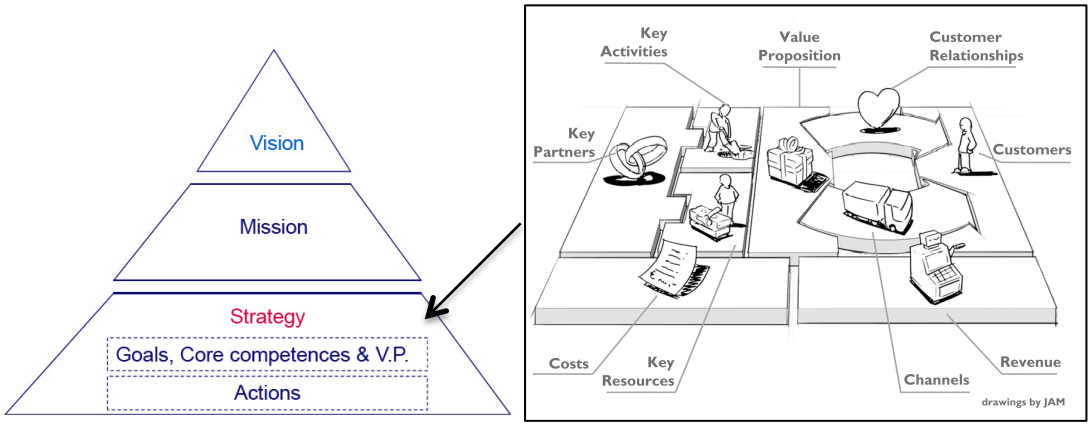


Figure 6 Business Strategy and the Business Model Canvas (Source material: (Cloodt 2013) (Osteralder 2010))

The well-known Osterwalder Business Model Canvas (BMC) can be seen as a representation of the bottom of the pyramid. It was used as a starting point for the research Framework, as it represents an often used structuring of the Business Model and is therefore understandable to many actors potentially involved. BMI theory indicates that at least two aspects of the Business Model need to be Innovated, preferably from both the Value Proposition and the Operation Model to optimally grasp BOs. (Lindgardt et al. 2009)

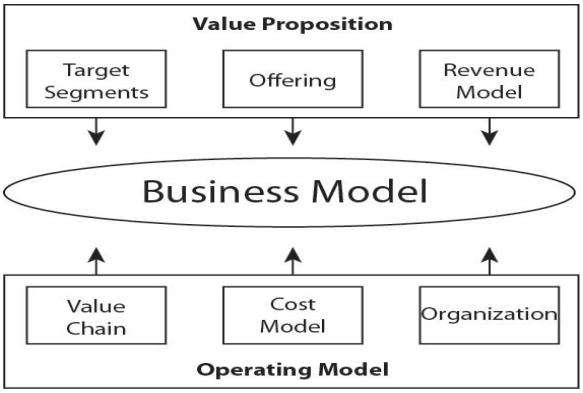


Figure 7 Potential Components of the Business Model to Innovate (Source Material: (Lindgardt et al. 2009))

Combining the concept of the Business Strategy Pyramid, BMI through the innovation of at least two aspects of the Business Model and the Business Model Canvas resulted in the overall research framework for this research on grasping RSC BOs as depicted in Figure 8 Research Framework. This framework doubles as a reading guide. Methods and results will be presented in a format following its structure. Lastly, although the framework structure and ad-hoc research strategies implemented suggest a subdivision of strategies on different aspects, the overall goal will be to combine the different lines of thought into a single cohesive RSC Model and Strategy. Some additional thoughts on Business Strategy as related to RSC that are worthwhile to discuss but not essential to the line of thought of this research can be found in Appendix 1.

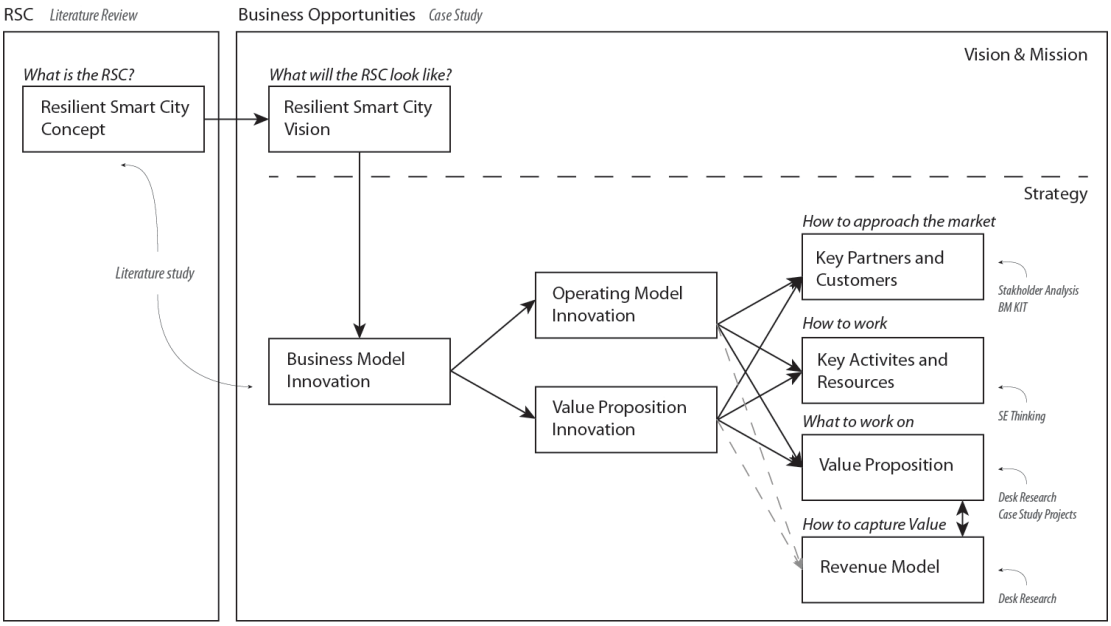


Figure 8 Research Framework

2.2.2 Vision and Mission

For the purposes of this research the Vision and Mission part of the Business Strategy can be combined in a RSC Vision. Usually the vision presents a dot on the horizon to strive for and the mission is the present reason for being for a company. In this case both concepts have to

be developed and the best way to do so is in cohesion. Splitting them in such an early stage would be artificial. Goal of this vision is to offer a point on the horizon to aim for when establishing strategies and BM Innovations. It is of prime importance for understanding the value the company will offer to the marketplace. This vision should be closely related to the RSC concept established prior to achieve optimum value for both clients and end-users and the Engineering Firm themselves. Therefore this part of the research was conducted by combining the theoretical framework with case study experiences and additional desk research to develop a theory in the form of a RSC vision.

2.2.3 Key Partners and Customers

The RSC marketplace will be a new one in which most stakeholders are still searching for their position. Who are the customers?, how are they approached? When are they approached? etc., are questions involved. These issues are components of the Operation Model of the BM.

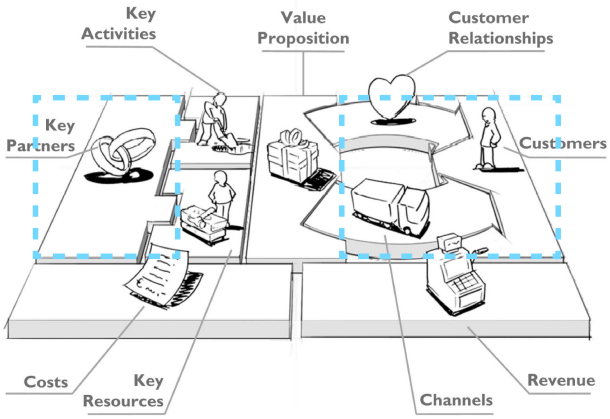


Figure 9 Key Partners and Customers as Innovation Areas (Source material: (Osterwalde 2010))

This innovation area was researched through an extensive stakeholder analysis. First the present Urban Development Marketplace was researched, then the changing conditions due to RSC developments and lastly a new way of approaching the marketplace to optimally grasp RSC BO is designed. The phrase RSC marketplace might be somewhat confusing, seeing as though it is still unclear what it consists of. Actually, what is discussed is the urban development marketplace where RSC solutions will have to find their place in the near future. In an actual situation the number of stakeholders in an urban development project is quite numerous. To keep a clear overview and not overly complicate the research without reason, the stakeholder analysis is limited to those stakeholders that are perceived as having the most direct interest in the process according to their power and interest.

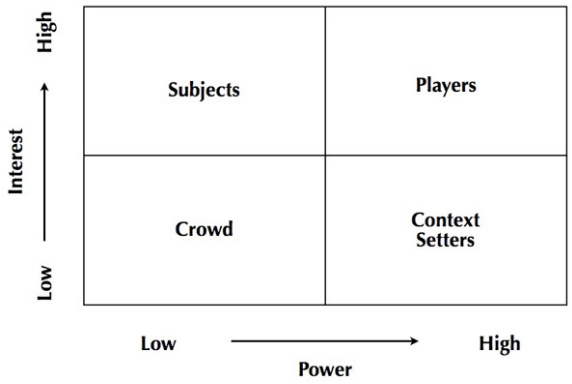


Figure 10 A Power-Interest Diagram

The stakeholders involved in the RSC marketplace where identified by desk research and explorative discussions with experts involved in the field. In some cases the stakeholders are simplified, or merged into archetypes to maintain a clearly understandable view on the market. This resulted in the following list of stakeholders involved in the Dutch market that is the present working field of Engineering Firms and that will form the basis for a future RSC marketplace:

- Engineering Firms (Vendors)

- Municipalities (Customers - Regulatory Body)
- Housing Corporations (Customers)
- Citizens (Customers - End Users)

- Project Developers (Customers - Complementors)
- Service Providers (Complementors)

The stakeholders prime relationships to the other stakeholders are presented graphically, to gain immediate insight. This is done through the Business Model Kit, developed by the Board of Innovation, an international office specialized in Intrapreneurship and Business Model innovation. (Board of Innovation 2015) This is actually a tool to help innovate Business Models, but because it does so by representing stakeholders and their relationship towards each other it is perfectly suited for this goal. Lastly, as end-users for this model citizens were chosen. In cities there are obviously other end-users, such as businesses, industry, etc. However due to the emphasis on citizen needs in RSC thinking and to keep the model understandable, citizens are the only central end users. For other purposes phrases like citizens and housing could easily be replaced by companies and offices for instance. As such, the focus on citizens and the housing market acts as a case study for the broader marketplace.

2.2.4 Key Activities and Resources

Secondly, the way an engineering firm works can be innovated to suit RSC implementations. This is closely related to the Key Activities and Resources in the Business Model, as depicted in Figure 11.

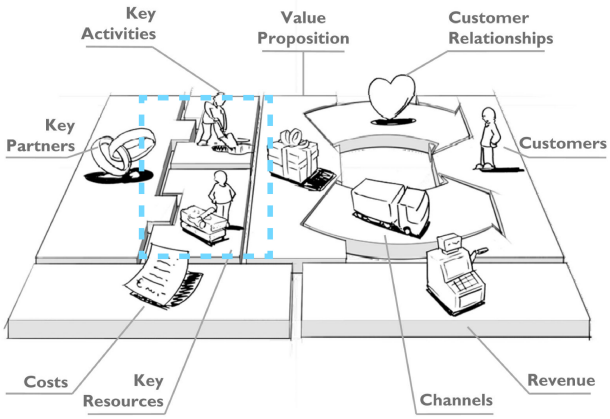


Figure 11 Key Activities and Resources Innovation (Source material: (Osterwalde 2010))

Importantly, the goal of this area of innovation is not to design an Engineering Solution. Specific technical solutions within Engineering Firms span a broad range of specialties, and especially in the Urban Development market, the market related to RSC solutions, solutions are uniquely site specific. The goal is to sketch where RSC Engineering practice differs from traditional practice within a company like Grontmij, and as such indicate how this practice should change, and therefore how the Offering will change. As such, the Innovation is not a fixed product or service, but a new way of thinking, or at least new elements in thinking, behind the products and services that will be offered.

The Innovation of the Engineering Practice will be depicted as a standard Systems Engineering Process. This is not done to suggest that the organization should tackle all its projects by implementing Systems Engineering. It does offer some advantages however:

- It is a helpful visual aid, to show the phases of designing Engineering Solutions
- It is a process used for complex problem solving in a systematic way, which is useful when thinking about an Innovation process
- It places specific customer requirements over standard systems, and as such helps thinking about Innovative Solutions
- It is based upon Customer Requirements, which closely matches the RSC goal of the Empowerment of citizens.
- It includes organizational aspects as well as Engineering aspects, which could also be part of possible innovations.

2.2.5 Value Proposition

Lastly, the offering itself will need to be innovated; a RSC service will need to be developed. As such the Value Proposition will be innovated. Innovation in Target Segments is less relevant because all segments need to be targeted for a successful RSC implementation. The revenue structure for an Engineering Firm is quite straightforward and no previous research indicates that it is a prime area for successful innovation, although it might very well adapt due to changes in other areas. Figure 12 indicates this area of innovation as part of the well known Osterwalder Business Model Canvas.

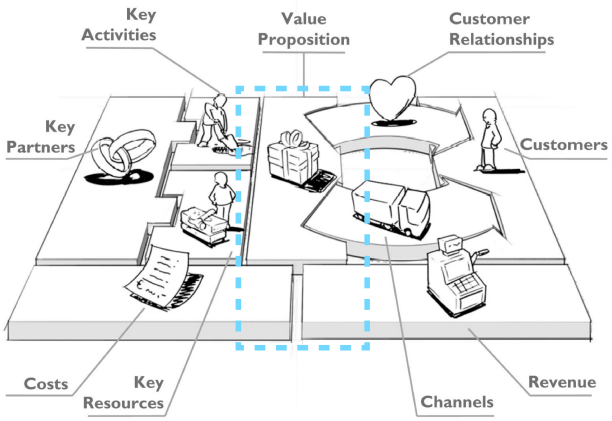


Figure 12 Value Proposition Innovation (Source material: (Osterwalde 2010))

To conduct this part of the research the RSC Vision will be projected onto the present areas of expertise within Grontmij Gebiedsadvies, as depicted in Figure 13, and combined with Case Study experiences to develop a Value Proposition that both meets RSC requirements and at least partially matches the kind of services the company is familiar with.

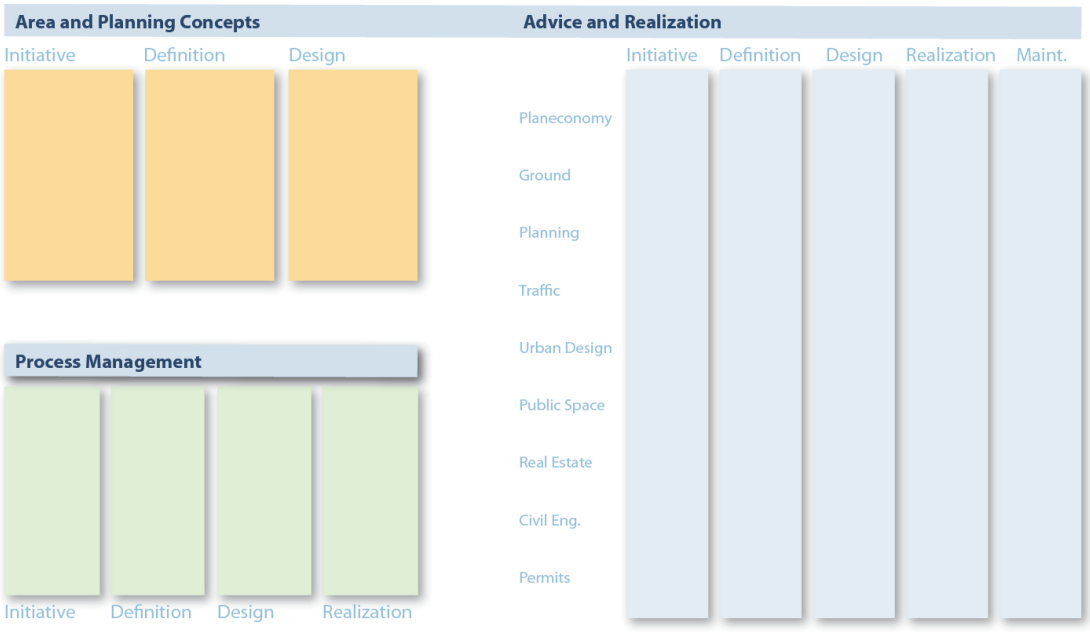
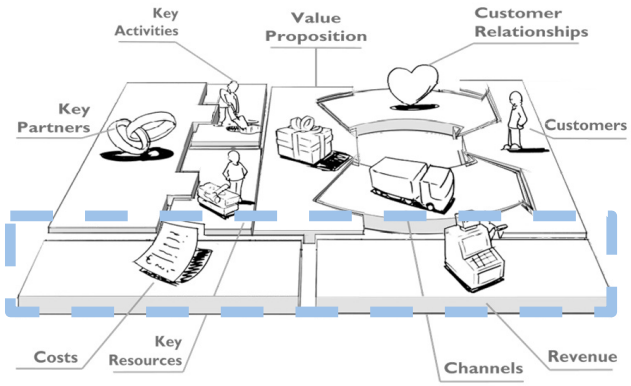


Figure 13 Working Areas Grontmij Gebiedsadvies (Grontmij 2015c)

2.2.6 Revenue Model

Lastly, the Revenue Model behind the Value Proposition will be discussed. For this the most important financial implications of the suggested strategy will be discussed, and a number of potential revenue models will be analyzed for there suitability as related to the types of RSC service, combining desk research with the case study.



3 ANALYSIS

3.1 A Resilient Smart City Scenario

A Resilient Smart City is a city that empowers its citizens to help it develop Efficiently and Sustainably, through Resiliency solutions. This paragraph describes how this definition can be translated into a RSC Scenario. This scenario will act as a starting point to build strategies and recommendations upon in the following paragraphs. Eventually, the combination of the scenario with these strategies and recommendations will lead to an integrated RSC Vision as part of a Business Strategy.

The goal of the scenario is not to define actual technical solutions, these can greatly vary over time and location and stating defined solutions might limit creative thinking. The goal is to localize the relationship between the possible domains of RSC solutions, the scale at which these domains operate and most importantly the stakeholders involved. An abstraction of such a scenario can be found in Figure 14 A RSC Scenario

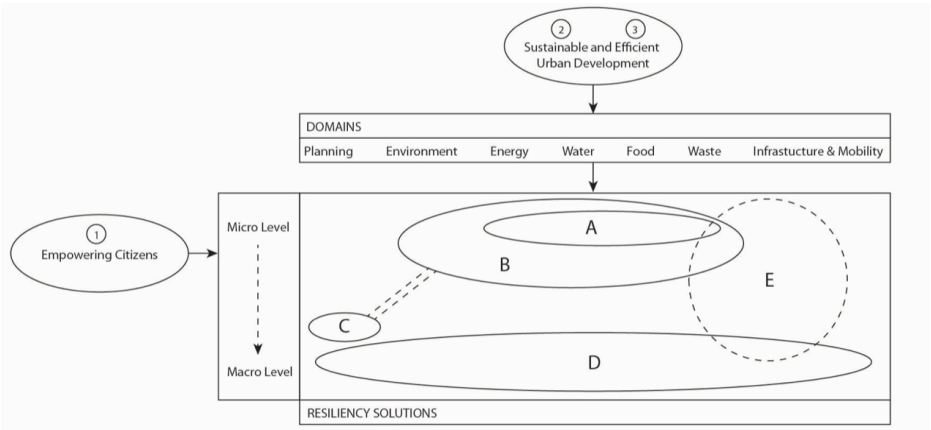


Figure 14 A RSC Scenario

The figure shows at what levels different RSC domains can help fulfill its three basic goals through resiliency solutions. At its most basic level, decentralization of city systems towards the lowest possible level helps in both adaptability and the empowerment of citizens and therefore is a very desirable RSC solution. However, not all systems can or should be decentralized, others work better at a meso-level of neighborhoods, and still others require a complicated integration of technical solutions on all levels. The different areas of interest in the scenario are briefly discussed below:

A. The level of individual households. Systems like energy production, water retention and purification, waste recycling and even small-scale food production can help make households more self-reliant and resilient. The dominant actor at this level is the citizen.
B. The level of neighborhoods. Some of the systems mentioned in the level of individual households work much better when combined at a neighborhood level, such as local energy production. Peaks and shortages between households can be managed and storage can be afforded. Also, systems that are too large for level A can be part of this level, such as collective green environmental solutions. Dominant actors at this level are (Communities of) Citizens, Housing Corporations and Project Developers
C. Municipality Planning. For many RSC solutions in levels A and B planning changes are required or desired. Do neighborhoods still require spatial planning laws?, are individual houses still required to be connected to city sewage systems?, etc. The dominant actor is the Municipality
D. The macro level of the Municipality. This is the level of public works for solutions that are too large to manage at an even smaller level. At this scale a city needs to be adaptable to be able to cope with changing circumstances, environmentally and economically. Concrete examples include smart infrastructure that can handle urban growth and shrinkage over time and smart environmental solutions for high water situations at a large scale. The dominant actor is the Municipality.
E. New RSC Mobility solutions are an area in themselves. they touch upon all levels of the city, but are still very difficult to predict, due to their highly technical nature. A logical direction would be an evolution towards 'individual public transport', shared solutions for individual requirements. This sort of evolution would have large spatial impacts on all levels. The dominant actor is still unclear, although legislation will likely play a important role.

3.2 Key Partners and Customers - How to approach the Market

The relationship between the most important stakeholders in both the present Urban Development Marketplace and the fictional future RSC Market has been extensively researched in a step-by-step format textually and graphically in Appendix 2.1. Here, the central aspects are discussed.

3.2.1 The Present Urban Development Marketplace

Combined together the different roles and relationships between the actors in the Urban Development marketplace provide insight in the overall Business Model of this market. The most essential relationships are depicted in Figure 15. It is important to note that this model was constructed mainly from the viewpoint of an Engineering Firm and only includes the most essential players and relationships that are perceived to be involved in the present market, and the potential future RSC market.

Some central conclusions can be drawn that can be important towards a changing RSC marketplace. There are two major development areas: public works and housing areas. Here housing areas could also be office areas/industrial areas, etc., so an alternative distinction could have been that between the public grid of the city, and the infill between this grid. Secondly, municipalities steer their Urban Development, through direct involvement, especially for public works, and Spatial Planning Documents and other regulations, especially for housing areas. On the subject of housing, there are three basic types in which citizens are provided with their housing needs: by individual building initiatives, through Housing Corporations and through Project Developers The same project Developers are also involved in the realization of housing needs through Housing Corporations. Overall, initiative for Urban Development mainly lies with three parties: Municipalities, Project Developers and Housing Corporations, although the last can be seen as partly being steered by government. On Engineering Firms, an important subject for this research, the following can be said: Through their role as advisors Engineering Firms can be involved with virtually all other stakeholders, traditionally in this role they act re-actively, and EFs are not necessarily often directly involved with Citizens.

3.2.2 Changing Roles and Requirements in a RSC Scenario

In their role as advisors Engineering Firms are already able to sell services to all other stakeholders in the Urban Development market, in virtually all domains. Through their broad expertise they poses all the required knowledge to help implement RSC solutions, or are easily able to acquire this knowledge.

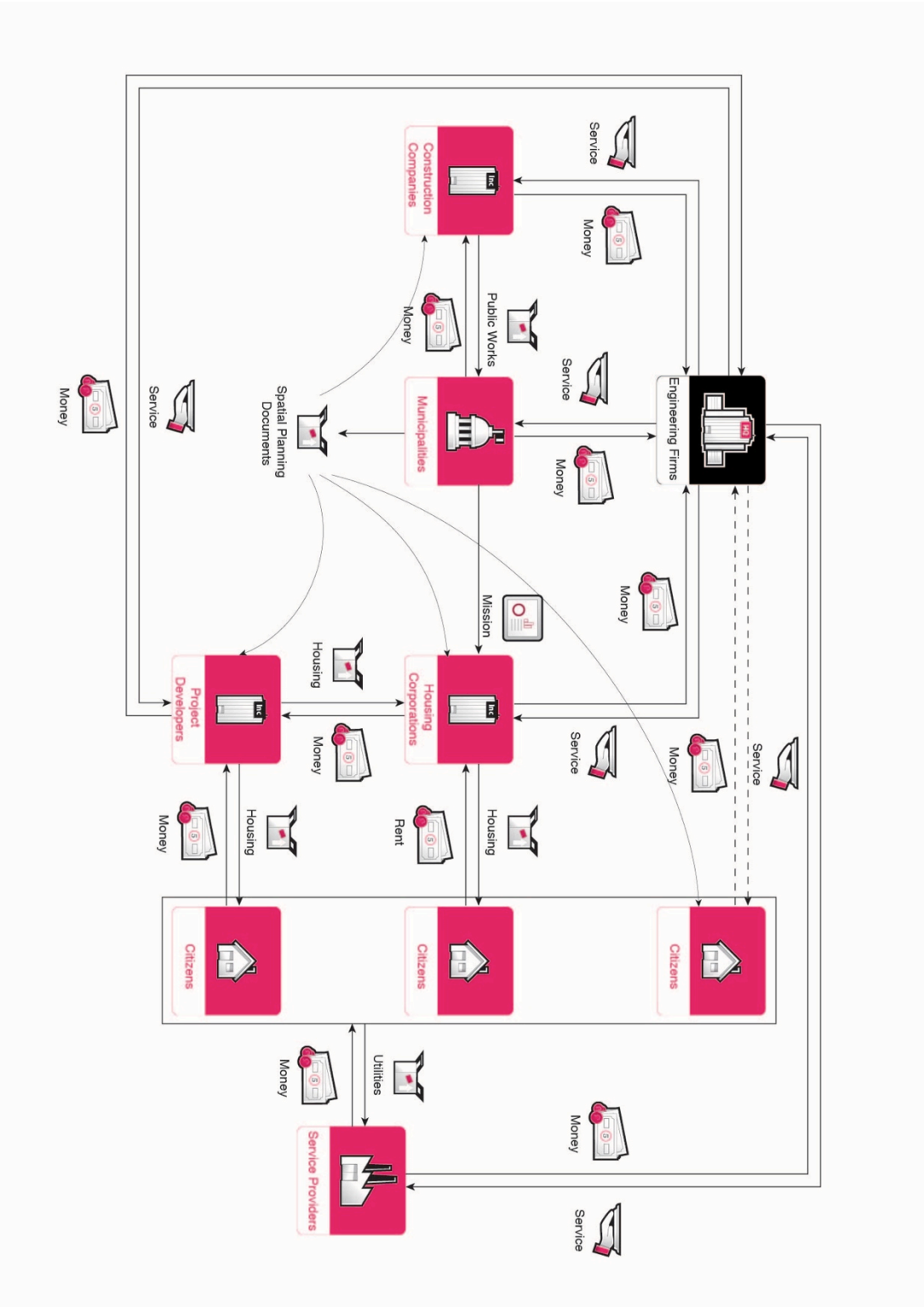


Figure 15 The Urban Development Marketplace Depicted as a Business Model for Engineering Firms

However, present practice shows that this combination of a decent market position and all the required knowledge has not proven to be sufficient to result in a strong RSC Business Opportunity. The analysis of the changing roles and requirements for the most important stakeholders that a changing RSC Marketplace scenario implies, as extensively discussed in appendix 2.2, provides an indication of potential pitfalls. Municipalities should theoretically be interested customers, but are not necessarily knowledgeable on the subject. Likewise, Housing Corporations primarily stick to their core business, which does not include RSC solutions in an obvious fashion. Project Developers tend to build what the market demands, especially in a tight market, and through a variety of reasons the market does not demand RSC implementations. Citizens are the most important stakeholder towards the RSC, however they are not often knowledgeable on the subject and its implementations, despite the fact it stands to benefit them. Added to this, they often don't see a clear link between RSC solutions and their immediate needs.

3.2.3 How to act in the RSC Marketplace

In Appendix 2.3 a RSC Marketplace was theorized in a step-by-step fashion. Its outcome is represented in Figure 16 The Engineering Firm in an RSC Marketplace. Some central strategies on how to approach the RSC Marketplace as an Engineering Firm can be distilled from this image.

Firstly, an Engineering Firm interested in the RSC market should clearly position itself as the expert in RSC aspects, through a clear definition and stance, and active market approach. Related to this the Engineering Firm should act pro-actively in acquiring Business Opportunities, seeing as though the RSC marketplace is still in development and many stakeholders are more or less uneducated on the subject, and therefore uninterested. This implies taking a departure from standard Engineering Firm practice.

Not all stakeholders need to be actively approached extensively. The most important stakeholders are the Municipality and the private Citizen. Involving them in the right manner will most likely ensure indirect Business Opportunities with the other stakeholders, thanks to a changing market place. Approaching Municipalities and or Citizens pro-actively will require RSC services targeted at their perceived needs, and sometimes these perceived needs will need to be 'created' through active pitching of ideas. New types of services will most likely be required. This is a main focus of paragraph 3.4

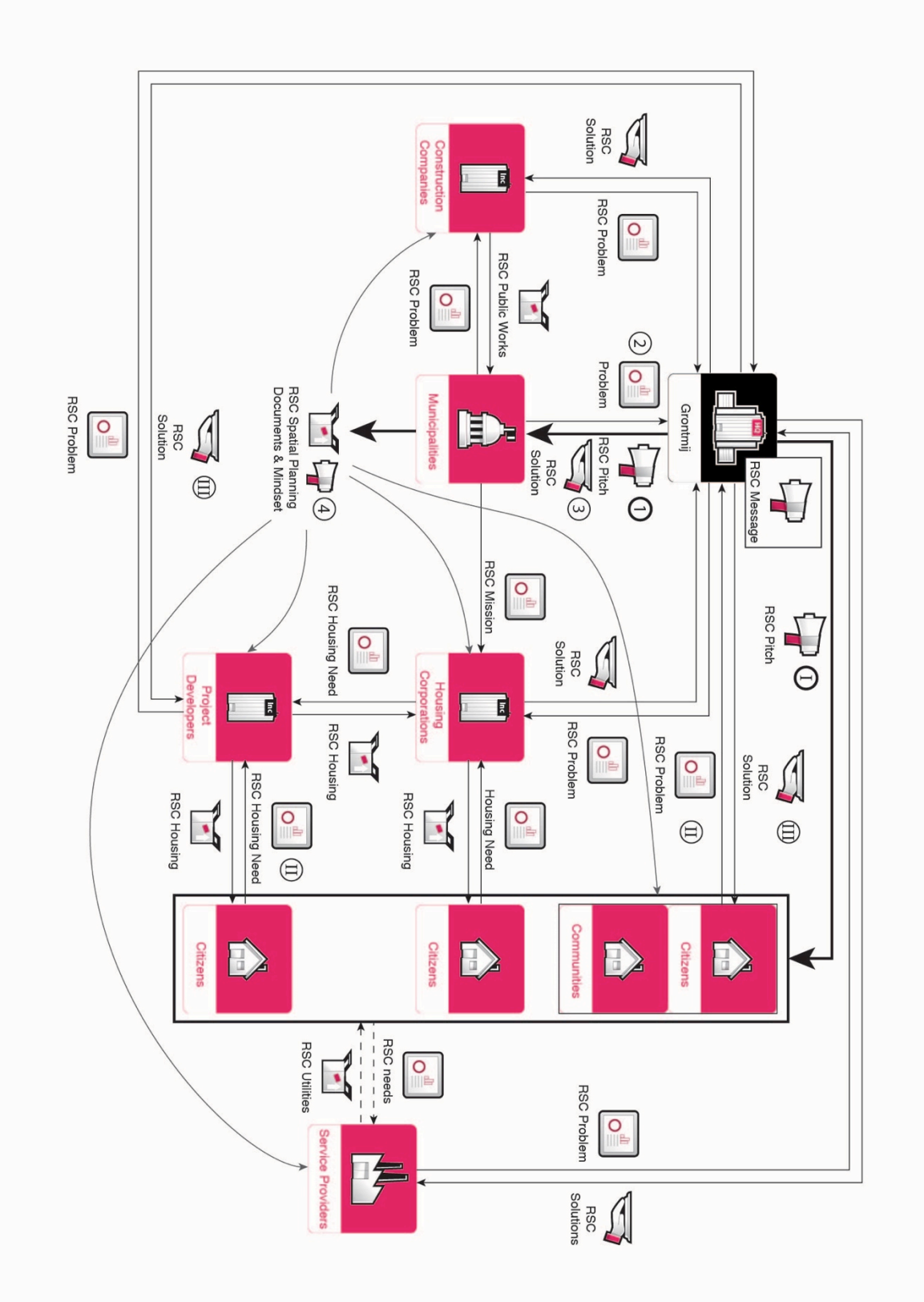


Figure 16 The Engineering Firm in an RSC Marketplace

3.3 Key Activities and Resources - How to adapt Engineering Practice

3.3.1 Requirement Analysis

In a traditional Engineering Project, Project Requirements are provided by the client. They are project specific and form the basis of Engineering Solutions. For a RSC this is still very much true, however added to this the three central RSC goals of Empowerment of Citizens, Efficiency and Sustainability are also part of the requirements, whether or not they were specifically mentioned by the client. As such, RSC thinking enters the future Engineering Solution at the very base by making this aspect explicit

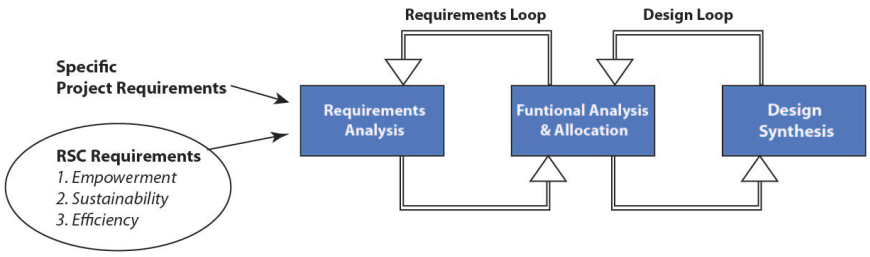


Figure 17 RSC Requirements in a Design Process

3.3.2 Functional Analysis and Allocation

This is the part of an Engineering Process where the requirements, now including RSC thinking, are translated into functions. The requirement is translated into a function to fulfill before actually providing a solution. This step is very helpful in RSC projects, because it helps in an essential aspect: the chance to come to creative, new solutions, instead of standard Engineering Systems. This is of prime importance for RSC projects because thinking about the RSC often requires rethinking the city. For instance: Will people still drive private cars? If not, will we still need roads? If not, what will we do with the reclaimed space?

Related to the Functional Allocation, in this phase the actual work to be done on a Engineering Solution is also divided. This is also an interesting aspect for RSC projects, because by their very definition they are very multi-aspected and integrative. A RSC solution will most likely include all systems of Urban Development, including water, energy, heat, utilities, ground work, design, regulations, etc. This implies an organizational structure that allows for work on a comparable multi-disciplinary scale. For instance, multidisciplinary project teams can be a better organizational form for RSC projects than a division based organization. This is specifically interesting for an Engineering Firm like Grontmij that is organized in a vertical division structure.

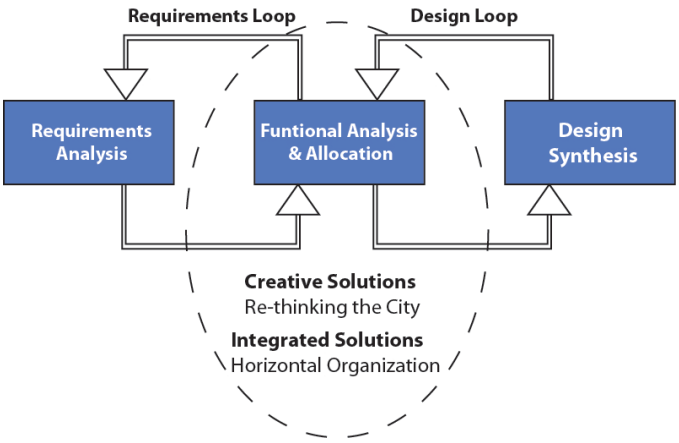


Figure 18 RSC Aspects in Functional Analysis and Allocation

3.3.3 Design Synthesis

After implementing RSC thinking from the earliest stages of a project through the requirements, and creative thinking and a smart organizational form in the Functional Analysis and Allocation phase, the requirements and functions are combined into Engineering Systems through design. This is labeled Design Synthesis. Here the actual Engineering Solutions are created based upon all the former input, and technical requirements. In the case of RSC projects, Resiliency Solutions should be part of these technical solutions. Resiliency Solutions will often help in meeting the RSC Requirements so they might arise automatically, but stating this aspect explicitly at this phase strengthens the likelihood of successful implementation.

Resiliency Solutions are based on one or all of the following qualities (Folke et al. 2010):

- Persistence: The ability to withstand forces
- Adaptability: The ability to adjust readily to different conditions
- Transformability: The ability to be adjusted over time according to circumstances

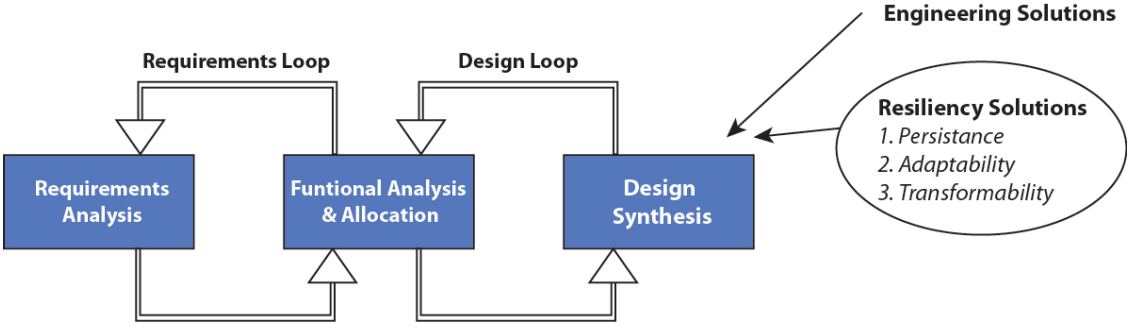


Figure 19 Resiliency Solutions in Design Synthesis

3.3.4 RSC Engineering Practice

Overall, thinking in lines of a Systems Engineering Process and implementing goals, tools and guidelines of the RSC, based upon its created definition, at the right place and phase of a project can help to Innovate the Engineering Practice, and therefore the Offering an Engineering Firm can make towards the RSC market. The different aspects are presented together in Figure 20 RSC Engineering Practice

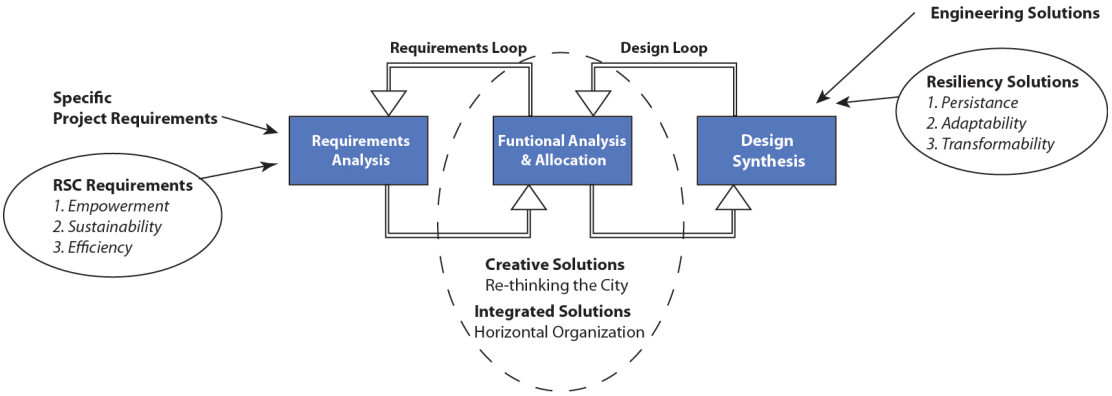


Figure 20 RSC Engineering Practice

At the same time, this innovation leaves the overwhelming majority of decisions to be made in an Engineering Project open to the Engineers involved, so solutions are still specific to projects and the engineers qualities and creativity as they should be. As such, the innovation of the RSC Offering as part of an overall RSC Business Model Innovation is quite subtle, but indispensable non the less, and requires essential strategy implementations.

3.4 Value Proposition - What projects to work on

3.4.1 RSC Entrepreneurship based upon present service areas

Before all else, entering or in fact partially creating the RSC market requires an Entrepreneurial state of mind. In many cases the demand will be unclear or non-existent while the Engineering Firm has the feeling it has a lot to offer. This implies that the Firm should act pro-actively, seeking out opportunities to create added value in different ways. This can be either by convincing potential customers of existing services, as discussed in paragraph 3.2 or by connecting to existing customer problems and needs even, if this means adapting the Value Proposition. Probably most competition will be less willing to do so, increasing Business Opportunities. The following paragraphs will propose an integrative service package Grontmij could work on, connected to types of services the division of Area Advice (Gebiedsadvies) is presently specialized in as depicted in Figure 21. The goal is to provide a starting point that is connected to the present staff and mindset.

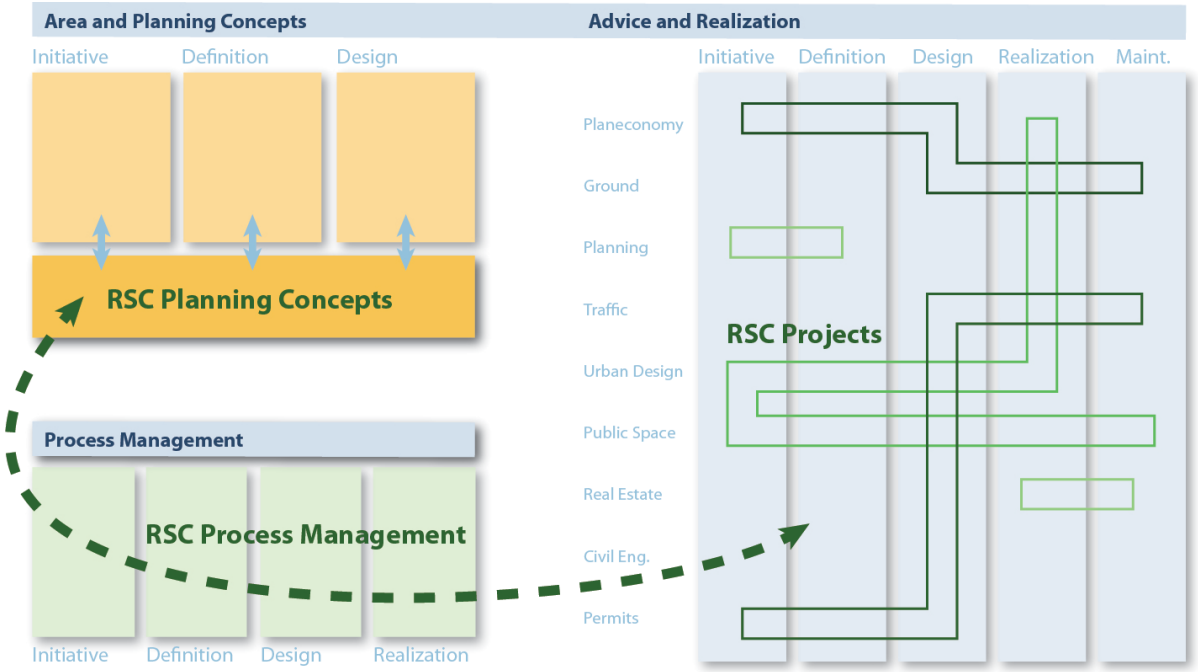


Figure 21 RSCs and Grontmij Service Areas

Starting of, the Engineering Firm should offer a top-down service that provides customers like municipalities with a vision on how to develop their areas as RSCs, RSC Planning Concept in Figure 21. For concrete bottom-up RSC projects, whether they are for government of private parties, Grontmij is more than capable of giving technical advice and realization. As described in previous paragraphs these services will often be of an integrative nature, including any number of different areas of advice in different phases. These ad-hoc service packages are represented in the image as RSC Projects. Lastly, process management will be required for RSC services. It will remain important in a traditional fashion as part of the successful realization of projects. Additionally, it will play an important role in connecting RSC projects to overall RSC Planning concepts, to ensure top-down and bottom-up initiatives work together and enhance each other. As such RSC Process Management as it is indicated in the image will be marketable as a self-standing service to potential customers.

3.4.2 Concrete RSC Services

Providing a RSC Framework - Physical Development Plans

Unlike the traditional Smart or Sustainable city with is based on the idea of a fixed state the Resilient Smart City adapts, changes and optimizes itself to presented situations, being of an environmental, economic or any other nature. Largely decentralized systems will help bring this to be, but a from of central planning is also required. An important service an Engineering Firm can offer is that of providing a RSC framework that grounds RSC thinking in a municipality and facilitates bottom-up, organic, RSC projects by offering optimal freedom within this framework.

A concept for planning this kind of constantly adapting cities is that of the Physical Development Plan (PDP). The PDP shows the city's different conditions and states at different times. They are not final images of how a city will look at any given time, but a series of developing and fluctuating situations that depend on factors like climate, and changing social contexts. They are not concerned with fixed structures, but with systems and processes. (Andersson 2015) Figure 22 provides an example of a PDP based upon rainfall scenarios and Figure 23 indicates the relationship between environment and the built plan.

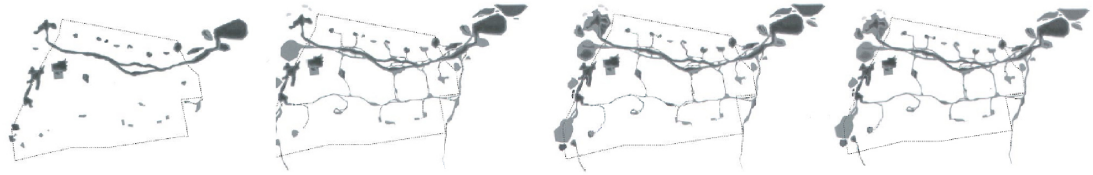


Figure 22 Physical Development Plan Water (Andersson 2015)

Figure 23 Physical Development Plan Environment and Built Plan (Source Material: (Andersson 2015))

In more traditional resiliency thinking the PDP consists of an environmental layer and a built layer, but there is no reason not to expand upon this system with layers like economy and technology. Overall the PDP indicates how and why a city can develop Resiliently within exactly these contexts, without presuming to offer a final image.

For an Engineering Firm like Grontmij developing these sorts of plans for municipalities is an interesting Business Opportunity within the context of Integral Planning Concepts. It is a top-down, integral service describing the present and future city development in broad lines, involving many of the firms specialties including urban design, ecology, landscape planning, mobility, economics, etc. As such the PDP provides a framework for more organic bottom-up initiatives such as the ones described in the following paragraphs. In Appendix 4.1 a project Grontmij was involved in, Almere Oosterwold, that is connected to this line of thinking is discussed to illustrate both the willingness of the company and the feasibility of the concept.

Managing RSC Urban Development Processes

An Engineering Firm can offer Process Management for RSC in several different ways. In Appendix 3 individual RSC Process Management possibilities are discussed that are independent from the integrated service package discussed in these paragraphs. These projects were left out of the main body of this paper because they would potentially cloud a streamlined line of thinking. They could be interesting to explore anyway, however the validation project in Appendix 4.2 that discusses a concrete attempt at such projects indicates an unclear, difficult feasibility.

Within the integrated service package, process management can play an important in several ways. In short, it can form the link between a top-down RSC framework and concrete (bottom-up) RSC projects. RSC project managers can help municipalities with RSC ambitions to judge where potential projects lie, which projects should be supported, which projects should be adapted to attach to existing projects and goals, which projects can be connected to each other, but also which projects do not contribute to long-term goals and should be discarded. Additional aspects like citizen-involvement, often propagated by municipalities can be integrated into this form of process management to further the RSC goal of citizen empowerment.

Likewise, RSC process management services can be offered to (communities of) citizens, developers, entrepreneurs, etc. following the same line of reasoning. RSC project managers can help interested parties to match their developments to municipality RSC goals. Who are officials to talk to?, what are plans and regulations to follow?, are there existing projects and/or funds and grants to connect to?, etc. In short, Grontmij can help clients to optimize the chances of projects being received positively and supported by municipalities.

Together, these forms of process management will help both municipalities and private parties to develop projects that are integrated in a RSC framework and therefore work together. This ensures that individual projects don't strand in wishful thinking and well meant but futile initiatives, or become obsolete in the short term. The added value for customers lies in creating a single instance that is knowledgeable on all aspects and actors related to an area. In this way an 'area-director' creates clarity and vision, and eases the tasks for other parties involved. For an engineering firm like Grontmij such an approach would ensure a central position within the RSC development of an urban area as the proverbial man in the middle and as such it constitutes a strong BO.

Grasping RSC Opportunities - Entrepreneurial Projects

RSC Business Opportunities can also be created by spotting existing urban questions and attaching RSC aspects to them. In this way added value can be created for the customers from the outset, and bottom-up RSC solutions can be implemented at a micro level as stepping-stones towards the Resilient Smart City. This way of working will require an entrepreneurial mindset, including a willingness to take risks and get involved in types of projects and services an Engineering Firm traditionally might not. Importantly, these sorts of projects can also provide value by offering a service that consumers are not interested in developing themselves. For instance, many citizens might be interested in living in RSC areas, but not in being actively involved in developing them.

A strong strategy is to target projects that are prevalent in local news and public opinion, or more generally are known to be a nuisance to government and citizens. A non-exhaustive list of examples is provided below:

- Empty Offices: In the Netherlands there is a huge amount of empty office space that is very unlikely to be rented out. Renovations and (functional) adaptations with RSC aspects in mind can make them attractive again.
- Dilapidated Business Parks: Upgrading declining Business Parks towards RSC Business Parks can make them unique and highly attractive to the right vendors. There is room for initiative from an active player in the urban development market.
- Urban Revitalization of aging Housing Areas: Continuously housing areas owned by Housing Corporations need to be revitalized. Pushing to make them Resilient and Smart instead of just 'Sustainable' will increase their long term attractiveness, value, true sustainability and long term cost of ownership for both the corporations and the inhabitants.
- Developing Municipality Owned Development Grounds: In better economic times Dutch municipalities purchased large amounts of land to develop as an investment strategy and to control the types of developments. Due to the economic downturn these grounds are not actively being developed, making them a financial risk for these municipalities. Although difficult, with the right strategy it might be possible to initiate and steer development of these grounds towards RSC implementations. Aspects like (future) livability, environmental consciousness and goals and city marketing could help sway municipalities to act, despite potential losses.

In effect, this service implies involvement in, or the initiating of, the actual bottom-up RSC projects that are taking place. This can either take the form of offering RSC engineering advice to existing actors, such as in the Smart City Maastricht project described in Appendix 4.4, or by developing projects on a risk baring basis in-house. Although this is not Grontmijs core business, in the right circumstances it can be a BO and there is precedent, for instance in the Ruimte voor Ruimte projects that the company undertakes, discussed in Appendix 4.3.

3.5 Revenue Model - How to capture Value

A last question is how to actually capture the value of RSC services, how to make money. To fully understand this subject it is vital to acknowledge the financial implications of RSC aspects for both Engineering Firms and customers.

3.5.1 Engineering Firm costs and benefits

For the Engineering Firm initial costs will be high due to added investments in strategies for customers & partners, resources & activities and the revenue model, as discussed in previous paragraphs. In the long run costs will drop back down due to increased knowledge on the subject, the market and experience in operation. On the benefit side, initial increase will be low due to the newness of the market. Customers will need to be convinced. However, once the service becomes successful the uniqueness of the value proposition implies a huge potential for growth due to a lack of true competition, although eventually competitors might step up. Overall, the balance implies a beneficial BO, as illustrated in Figure 24.

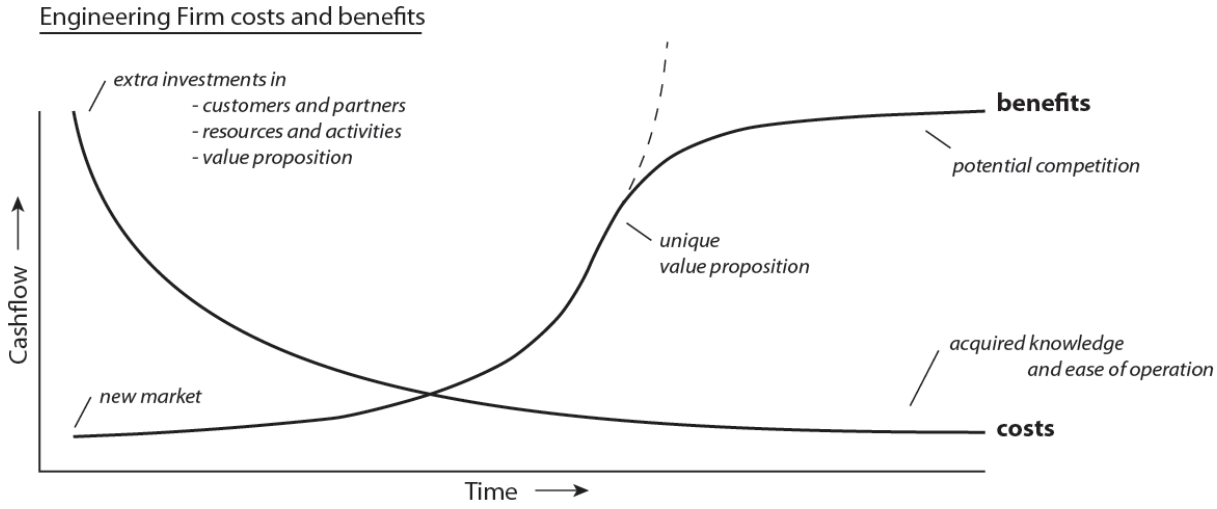


Figure 24 Engineering Firm costs and benefits

3.5.2 Customer and Societal costs and benefits

The central phrase for customers is Total Cost of Ownership. Many of the real-world implementations of RSC systems will require a relatively high initial investment, in return for lower than traditional running costs in the long run. This is a direct result of the need to implement new systems that will result in improved self-reliance and resiliency. Adding to the systems over time will quickly become more cost effective. (For instance, building a power grid for the first 1000 inhabitants is expensive, but the next 10.000 will also be able to use it.) Depending on the quality of the solutions implemented, the overall Cost of Ownership should be equal or lower than traditional costs. This is illustrated in Figure 25.

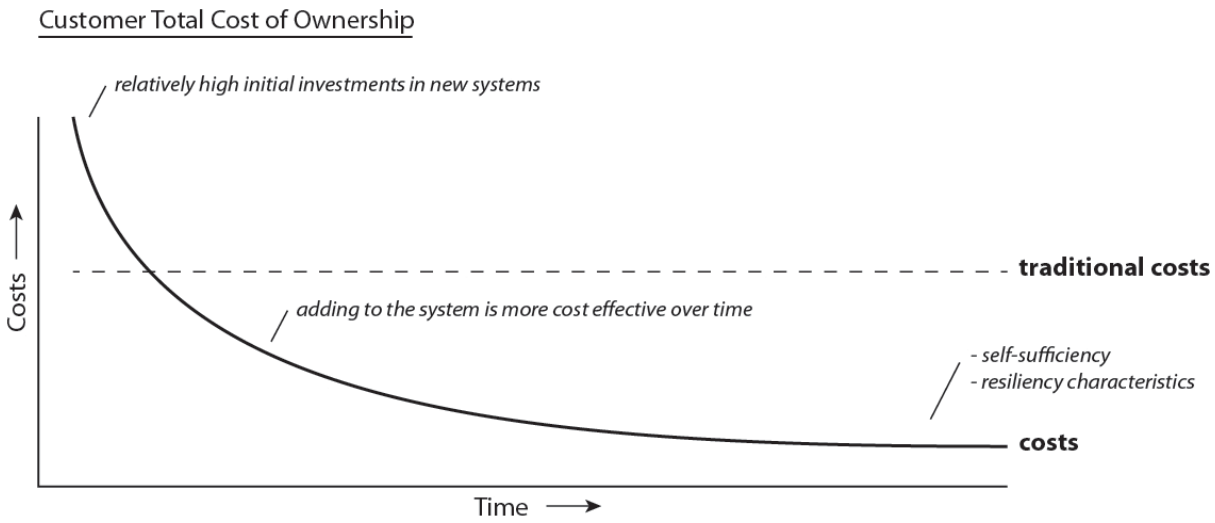


Figure 25 Customer Total Cost of Ownership

The customer's benefits closely match societal benefits. Due to the focus on the empowerment of citizens ***People*** prosper directly, but of course, they also prosper from a healthier, greener, more efficient environment. The ***Planet*** prospers due to the focus on resiliency and sustainability issues. Most interestingly for this Business case, ***Profit*** stands to increase exponentially. Not only will a more efficiently run urban area be more profitable, the positive effects on the People and Planet will act as a multiplier. For instance, healthier, happier people will be sick less often and therefore more productive, etc. This effect should act as a further incentive to overcome the initial high investments. Figure 26illustrates this line of reasoning.

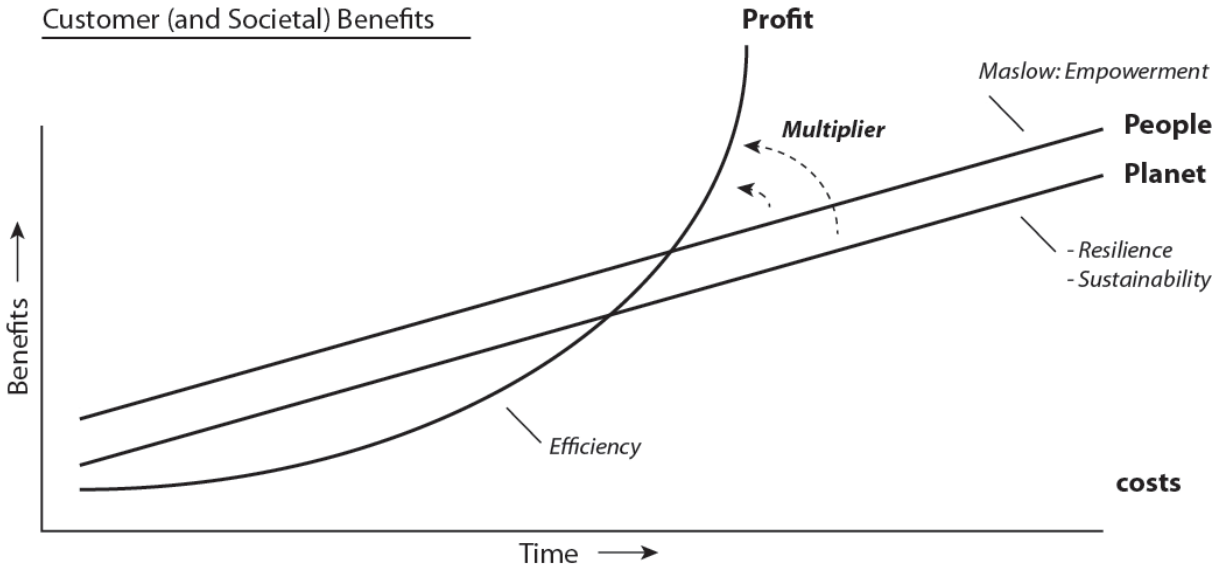


Figure 26 Customer and Societal Benefits

3.5.3 Revenue Model strategies

Table 5 provides a number of well known strategies for capturing value.

Revenue Model	Short description
Goods Retailing	One time sales of products or sales
Subscription	Continuous Revenue on a Subscription basis
Usage Model	Pay per amount of usage. Example: electricity
Bait Model	Sell a cheap starter product that requires expensive parts, like razorblades
Start-up Model	Start a product for free, to hook a customer for paid services later on
Combined Sales	Sell a product combined with a desirable product
Service Model	Sell a product and service it yourself for long term revenue
Advertising Model	Make money through third party advertising attached to the product.
Realtor Model	Earn a percentage of added value.
Market Information Model	Sell information gained from the market through other activities.
Rent and Lease	Renting and Leasing instead of selling
Licensing	License other parties to use your property in return for payments

Table 5 Potential Revenue Models. Based upon (De Innovator 2015)

For RSC Planning Concepts the RM strategy is basic. These are services that can be sold to the customer trough a single transaction based upon a delivered product. Potentially, this service could be sold at a low margin, with the goal to lock-in customers for future services, through a kind of Bait-Model as described in Table 5. For the RSC Process Management it is less clear how services will capture value. That there is value for the customer was made clear through the previous paragraphs, but will the service create clear financial value so the customer will be willing to pay? To start of with, an advantage of the chosen interrelated service package, is that the RSC Process Management can be sold as a service belonging to the RSC framework, following the Service Model described in the same table. For the RSC framework to work optimally municipalities will benefit strongly from RSC Process Management, so this is a form of customer lock-in. The service itself can be paid for in a traditional manner, through either a subscription fee, simple payment per hour of service or the detachment of Engineering Firm personnel. However, if the customer does not experience direct added financial value for the service, or has no available budget a new strategy will be helpful. Something worth looking at is the Realtor strategy from Table 5, earning a percentage of added value instead of requiring direct payment. The hard part will be defining the added value. For a municipality this for instance will be increased tax income or permit-fees or the less tangible added value to the cities functioning and image. RSC Projects can be paid in a traditional fashion, as a single transaction based upon a delivered product. Alternatively, complex projects with high initial investment for instance could benefit from any number of financial constructions like total packages for design, build and management, or percentages saved from utility bills by city inhabitants. Added to this, projects where the Engineering Firm participates based upon financial risk will reek benefits from the actual profit of the entrepreneurship.

These strategies are highly reliant on specific project requirements and hard to predict, however in general original thinking in financing constructions will help feasibility and profitability. (De Innovator 2015)

4 RESULTS

This chapter will discuss the overall results of the method and analysis presented in the previous chapters. Each paragraph is closely related to the corresponding paragraph in these chapters. In essence, it contains a tool-set for grasping RSC Business Opportunities. The results consist of four major parts: A RSC Vision to act as a starting point for any potential business action, a RSC Value Proposition, that suggest a potential service package to bring to market, a list of concrete Strategic Recommendations to translate the vision into reality through Business Opportunities and a graphic model for grasping BOs that summarizes both the structure of the research and the results in two recognizable images.

4.1 A Resilient Smart City Vision

The RSC Vision presented here is the direct result of the combination of the RSC Scenario discussed in 3.1 with the strategies in the subsequent paragraphs. It provides the essential starting point for an Engineering Firm to start developing and offering RSC services, by offering a dot on the horizon to strive for.

The Resilient Smart City is a city capable of handling the most important challenges it faces now and in the future in the areas of livability, sustainability and citizen value. As such it focuses on people, the environment and the city and the relationship between these three. The concept of Resiliency, the ability to persist, adapt or transform according to changing circumstances, is extremely capable to deal with issues related to empowerment, sustainability and efficiency, or vice versa, areas that include these aspects successfully tend to be Resilient. Smart (ICT) technologies are provided with a clear resiliency goal and offer the tools to optimally implement and integrate systems.

In practice RSC solutions in the 'hard', physical, domain will revolve around the idea of tackling global issues locally, or the decentralization of urban systems to the lowest effective level. Top-down systems are used when needed and safeguard a development framework, for instance for systems like the environment, water and infrastructure based upon Resiliency. Bottom-up systems are used where possible, for instance for energy, rainwater and heating within this framework in a more organic fashion, adapting to local qualities and possibilities and striving for citizen involvement. The integration of the two levels will lead to added value through synergy. For the 'soft' domains - citizens, governance, etc. - the focus again rests on citizen involvement. Involving citizens, especially in the development and operation of decentralized systems, offers them the benefits of self-reliance, influence on decision-making, potential profits, etc. In short, it empowers them. This line of thinking is closely related to strong social trends of decentralized, pay-per use solutions like Uber and AirBnB.

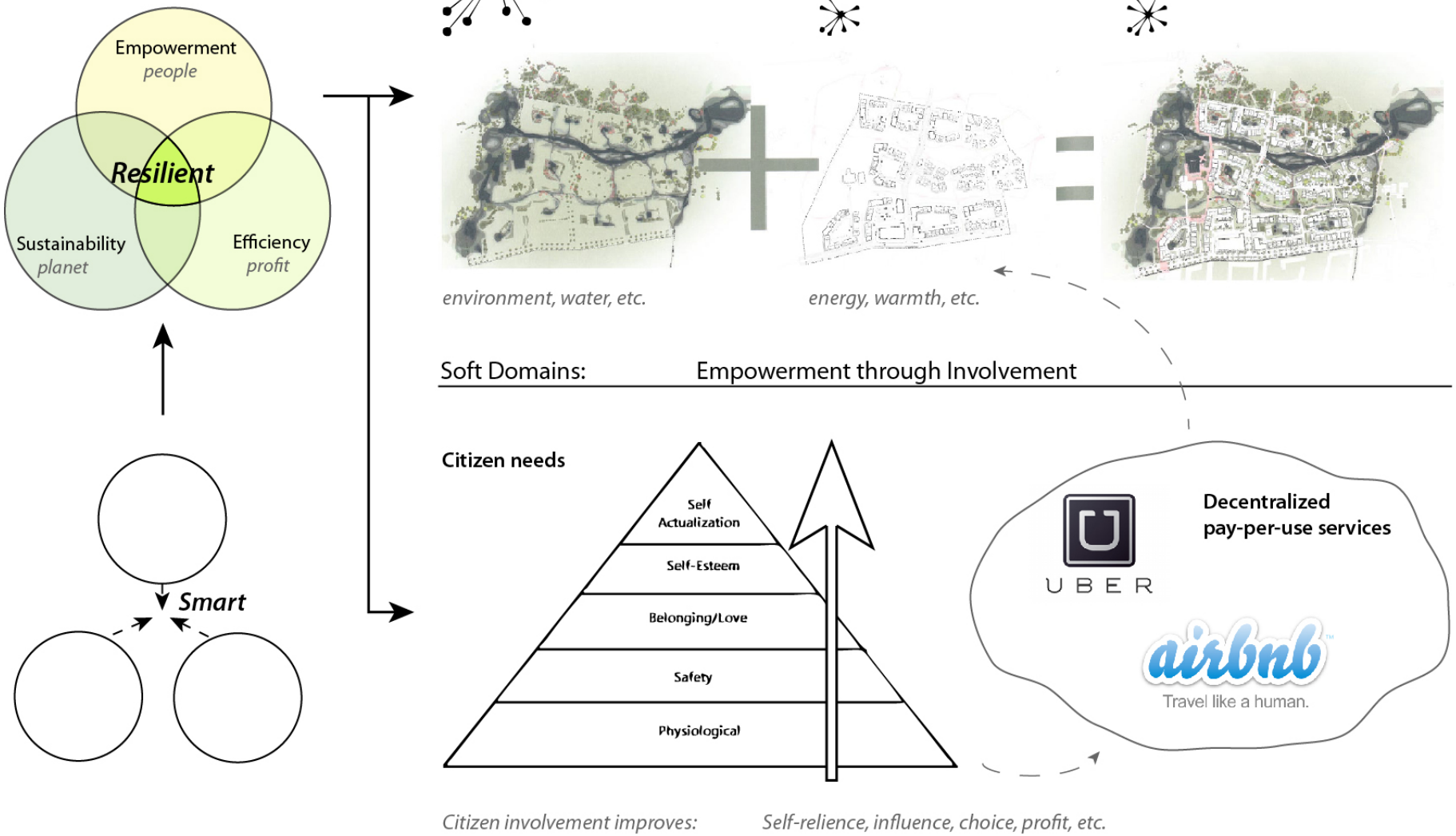


Figure 27 A RSC Vision

The RSC goes beyond traditional Smart City thinking by reasoning from these three end-goals based upon citizen needs, and not from available technological solutions. Similarly, it goes beyond the Sustainable City by not trying to futilely fight global systems that are largely out of there control such as peak oil, climate change and economical developments through static design and planning, but to adapt resilient solutions that help it develop in synthesis with these systems. This will allow urban areas to grow, but also shrink, in an efficient manner according to economic forces, adapt to technological and societal innovations and live with, as well as contribute to environmental issues. Next to this implicit citizen value, the Resilient Smart City is further set apart from traditional Smart City thinking by a central focus on the explicit value the city can offer to its inhabitants through empowerment. The RSC is based on the idea that citizens can, and want to, benefit from involvement in their own environments in questions like energy, water, waste, etc. but very importantly also that the city can benefit from this community involvement. The most effective way to implement RSC solutions in a city is through bottom-up processes as well as top-down ones.

Financially the RSC is more than viable, although it requires above average initial investments. The lower Total Cost of Ownership in the long run, and the highly beneficial positive multiplier effects of happy, healthy and wealthy ***people***, a sustainable ***planet*** and the ***profits*** involved will help overcome this obstacle. The Resilient Smart City will be a very attractive settlement area and highly competitive by offering true value to their citizens in terms of livability and empowerment and it will be highly independent from outside forces for utility needs. In practice implementations will revolve around:

Figure 27 A RSC Vision illustrates a scheme connecting the different aspects of the RSC.

4.2 A RSC Value Proposition

A RSC value proposition should be based upon an Integral view on urban areas. The city is not seen as a collection of sub-systems to engineer, but as an integrated area where solutions on all sorts of aspects – both hard and soft - work together to make it more or less Smart and Resilient on the areas of people, planet and profit.

Figure 28 provides a translation of the line of thinking in Figure 21 and the types of services discussed in paragraph 3.4 into a concrete scheme of activities, service areas and scales of operating. As such it describes the specific, interconnected RSC service areas Grontmij could work on to optimally serve customers and grasp BOs. The services are by no means the only possible ones, but they represent a singular, integrated way of operating. This is beneficial for both the Engineering Firm, they do not need to initiate a wide array of new fragmented services, and potential customers, they are presented with a single strong service that meets al their needs in an integrative package.

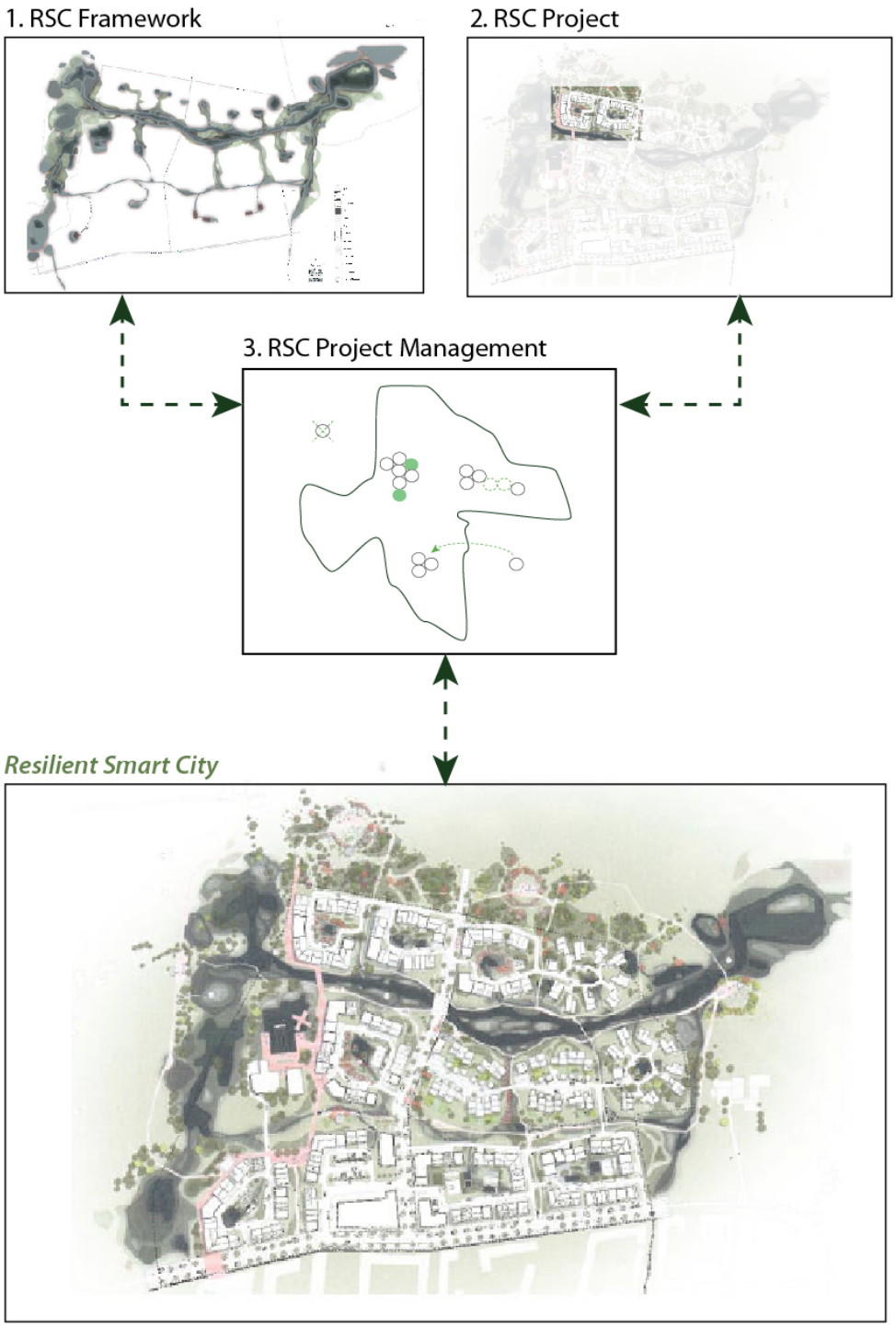


Figure 28 RSC Projects to work on. (Source material: (Andersson 2015))

4.3 Strategic Recommendations

With the RSC Vision in hand Engineering Firms can start working on a RSC Business Model. Table 6 provides a list of concrete strategic recommendations towards this Business Model. It includes recommendations on all the central aspects of the Business Model: Key Partners and Customers, Key Activities and Resources, the Value Proposition and the Revenue Model.

Nr.	Area	Recommendation
1	Partners & Customers	An Engineering Firm interested in the RSC market should clearly position itself as the expert in RSC aspects, through a clear definition and stance, and active market approach
2		The Engineering Firm should act pro-actively in acquiring Business Opportunities, seeing as though the RSC marketplace is still in development and many stakeholders are more or less uneducated on the subject, and therefore uninterested. This implies taking a departure from standard Engineering Firm practice.
3		Not all stakeholders need to be actively approached extensively. The most important stakeholders are the Municipality and the private Citizen. Involving them in the right manner will most likely ensure indirect Business Opportunities with the other stakeholders, thanks to a changing market place.
4		Approaching Municipalities and or Citizens pro-actively will require RSC services targeted at their perceived needs, and sometimes these perceived needs will need to be 'created' through active pitching of ideas. New types of services will most likely be required.
5	Activities & Resources	Make RSC requirements and Resiliency solutions an explicit, vocalized, part of projects from an early stage.
6		Time and Budget needs to be allocated for product development pro-active project acquirement. This sounds trivial but in an organization based upon billable hours it is not.
7		Integrated solutions require integrated Project teams, so for RSC projects a horizontal project team structure would be beneficial.
8		Project Managers need to be 'broad' Engineers, interested in a wide range of subjects and capable of spotting and building upon Business Opportunities.
9	Value Proposition	Offer the development of Physical Development Plans as a top-down RSC frameworks to interested parties such as Municipalities. This will provide a clear vision and mission for Municipalities and a framework for organic bottom-up projects. The development of such plans can draw upon many of the areas of expertise present within Grontmij
10		Offer RSC Process Management to both municipalities and private parties to link individual projects to a RSC framework and become a central player in the RSC development of an Urban Area.
11		Citizen Participation can be a unique selling point towards municipalities and citizens while also help achieve RSC goals.
12		Attach to existing projects that have a high chance of succeeding due to public and private interest and adapt them towards RSC aspects to add value.
13		Offer RSC Engineering advice to existing project initiators.
14		When spotting strong BO develop RSC projects in-house on an Entrepreneurial, risk baring, basis.
15		Integrate the RSC Services into a single, inclusive package, where each service provides added value to the other. This provides a single focal point for the company and an easy transition for the customer.
16	Revenue Model	Emphasize the lower Total Cost of Ownership and the beneficial multiplier effects between people, planet and profit to overcome a fear for higher initial investments.
17		Utilize the integrated RSC service package to lock-in the customer for added services like RSC Process Management
18		When customers don't perceive direct added value use original financing strategies like the Realtor Revenue Model.

Table 6 List of Recommendations

4.4 A Model for grasping RSC Business Opportunities

The structure of the BM Canvas formed the starting point of the structure of this research. Therefore it is an interesting exercise to fill it in for RSC Business Opportunities for Engineering Firms. As such the strategies and recommendations of the previous paragraphs are partially summarized and relationships between some of them become clear through a recognizable format. It is however by no means a complete representation of the total research and its outcomes. In Figure 29 the numbers and arrows crudely indicate the order in which the different building blocks relate to each other. It is a Business Model that is based upon a Technology Push starting point, the RSC, but this technology is defined and thought out in such a way that by definition it creates value for its end-users and therefore is relevant. In a very early stage it aims to involve the customers, or partners, in the development and implementation of RSC solutions, both to increase the likelihood of success and the quality of service.

The Business Model Canvas is just part of the overall strategy that is summarized in Figure 30. The RSC vision and different aspects of Business Model Innovation discussed in this paper work together towards this model. In cohesion they provide an overall strategy to grasp RSC Business Opportunities through both top-down and bottom-up RSC projects aimed at all customer segments but especially at creating value for municipalities and citizens. Together this way of working represents a strategy to set the Engineering Firm apart from the competition by doing something different that creates true value for the customer, and is effectively brought to a market that the company will have to create itself at least partially.

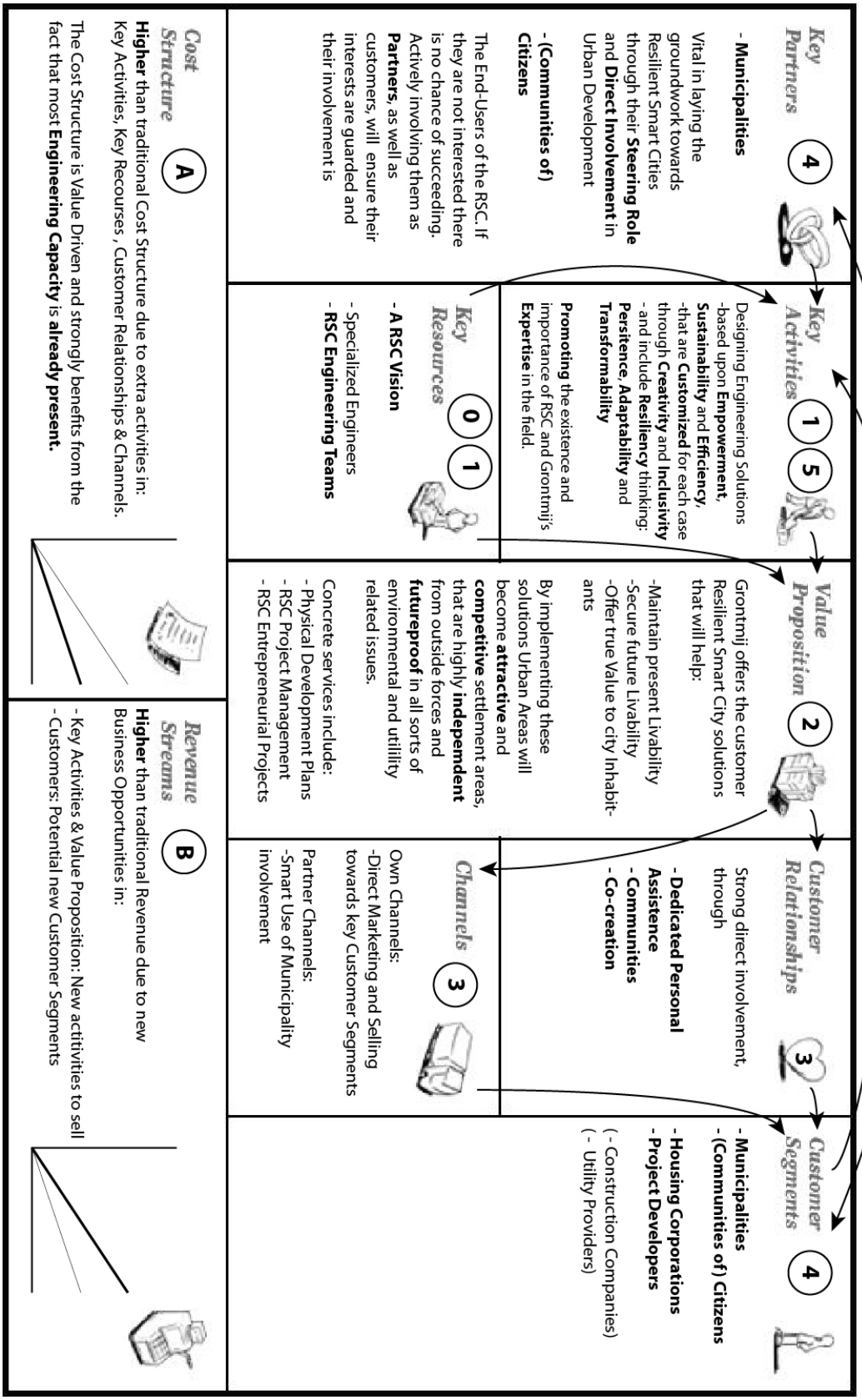


Figure 29 A RSC BM Canvas

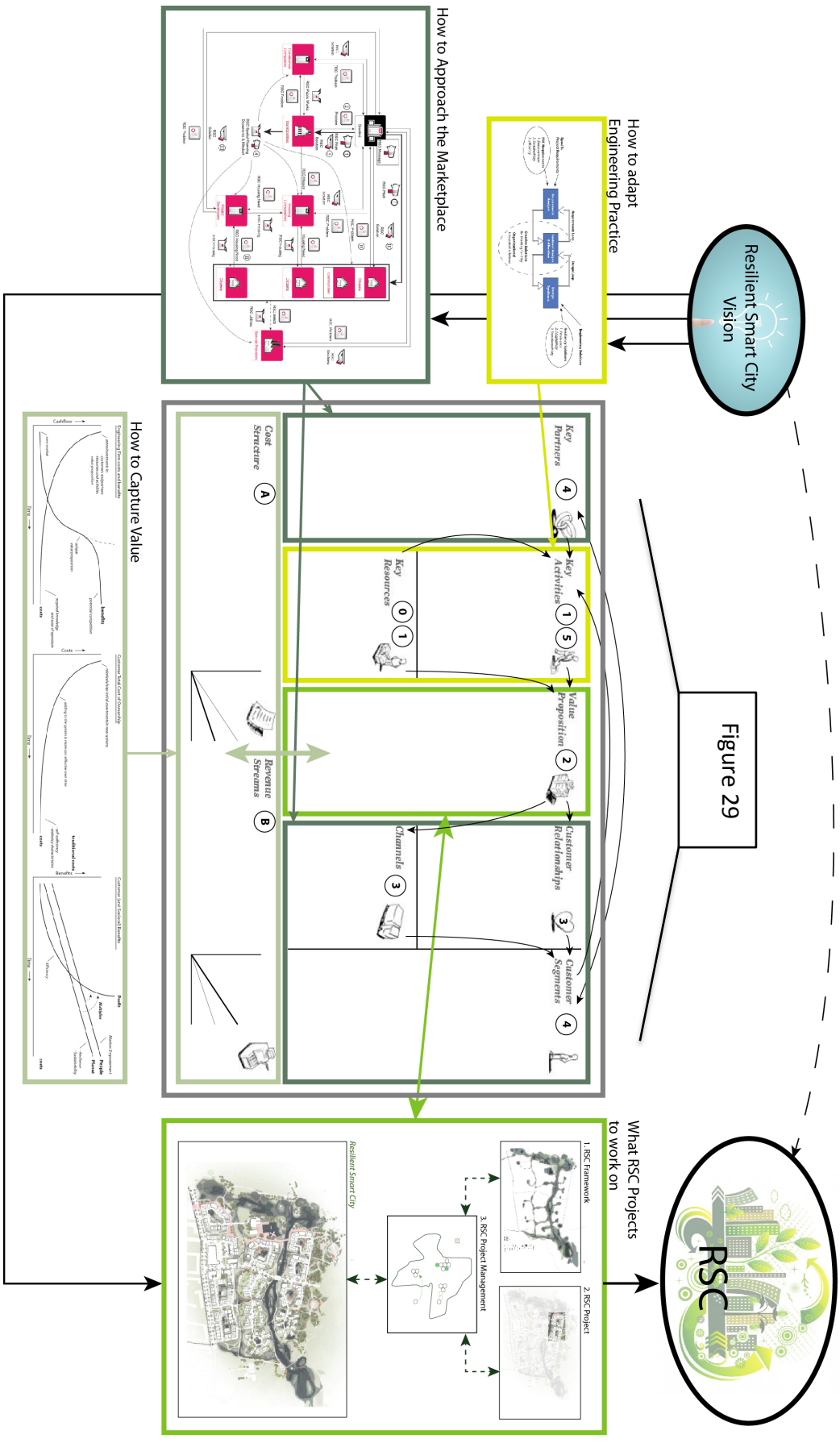


Figure 30 A Model for Grasping RSC Business Opportunities

5 CONCLUSION AND DISCUSSION

This paper set out to answer the question what it would entail for an Engineering Firm to grasp Business Opportunities in the field of Resilient Smart Cities, a concept introduced as a practical adaption and enhancement of the Smart City concept. (Kopp 2015) The hypothesis was that the implementation of RSC solutions could be strongly beneficial for urban areas and their inhabitants in areas like livability, sustainability and citizen empowerment, but was lacking due to a lack of stakeholders capable of facilitating it. Engineering Firms were introduced as suitable stakeholders who would be able to play a vital role by grasping Business Opportunities. A lack of suitable business strategies was seen as a major culprit and Business Model Innovation as a tool to research potential Business Opportunities. By using BMI as a research structure several aspects that are hindering RSC implementations at present were unearthed and strategies and recommendations to overcome these problems were defined and combined into an integral model for grasping RSC Business Opportunities. As such this paper answered the question what it would entail to grasp RSC Business Opportunities. Tangible products include the RSC vision, paragraph 4.1, a RSC Value Proposition, paragraph 4.2, a BM canvas like model on grasping BOs, Figure 30 and a set of concrete recommendations on the central BM themes of Partners & Customers, Activities & Resources, the Value Proposition and the Revenue Model, Table 6, that together can act as a starting point to offering RSC services. All indications are that an entrepreneurial mindset is most essential and (in)directly related to most recommendations. The types of services suggested are new, both to the company and the marketplace so a pro-active attitude and the willingness to dive in an unknown market are of prime importance.

Whether or not the hypothesis is fully supported falls apart in several facets. The potential benefits of the RSC concept itself for municipalities and their inhabitants are theoretically underlined by the previously mentioned literature review. Whether Engineering Firms are the right stakeholder to facilitate the implementation of RSC solutions was taken as a premise to the research so they could act as a case study. At the very least they are a interested party and research indicates they are strongly positioned. Following this line of thought the concept that grasping Business Opportunities is key in RSC implementations is a matter of fact, seeing as though strong BOs are a leading reason to act for any commercial company. Overall, the relationship between these sub-aspects means that some aspects of the hypothesis were supported by, while others remain based upon assumptions. This was a conscious choice to limit the scope of the research. The research method itself has some inherent limitations. A choice was made based upon the newness of the subject to use an ad-hoc, explorative and qualitative method with the goal to research the problem area at large instead of focusing on a very limited aspect. This was also an inherent property of researching BOs, a non-exact science. Although the research was structured as a case study and verification and validation was done through a literature review, explorative interviews, case study projects and desk research, there is no true check to see if results are fully valid, although the fact that the reference project that was undertaken during this research, Smart

City Maastricht discussed in Appendix 4.4, resulted in a concrete assignment for Grontmij and a significant grant from the European Union certainly indicates a level of validity. As such this study could act as a starting point for potential future invasive research on sub-aspects of the overall theory and specifically its use in a real world situation. On the level of content, although discussing a wide range of aspects within the area of Business Opportunities some aspects were omitted or discussed in less detail, such as financial aspects. This aspect was essential to discuss shortly because of its importance, but too complex to research in detail here. Again, this is an area for potential future research.

Overall, this study served several purposes. On a scientific level it continued the research started in the previously mentioned literature study and added to the knowledge on SCs in general in RSC specifically as well as Business Opportunities in the their fields. Also it added the use of BMI as a basis for research methodology. From a business point of view the research suggested strategies to grasp BOs that are at least partially validated and therefore would benefit an engineering firm like Grontmij if implemented. If not implemented the ideas in this paper can still serve as a sparring document to discuss new ideas. Lastly and perhaps most importantly, on a societal level any added value this paper can have on the realization of RSC solutions would help urban areas remain livable, become sustainable and empower citizens.

REFERENCES

Alvarez, S.A. & Barney, J.B., 2007. Discovery and creation: alternative theories of entrepreneurial action. *Strategic Entrepreneurship Journal*, 1, pp.11–26. Available at: http://doi.wiley.com/10.1002/sej.4.

Amit, R. & Zott, C., 2012. Creating Value Through Business Model Innovation. *MIT Sloan Management Review*. Available at: http://sloanreview.mit.edu/article/creating-value-through-business-model-innovation/.

Andersson, S., 2015. The Urban as a Resilient System of Processes. *Topos - The International Review of Landscape Architecture and Urban Design*, pp.22–29.

Board of Innovation, 2015. index @ www.boardofinnovation.com. Available at: http://www.boardofinnovation.com/ [Accessed March 20, 2015].

Byers, T. H., Dorf, R. C., Nelson, a. J., 2011. *Technology Venture from Idea to Enterprise*,

Chapman, R., 2012. Resilient Cities: Responding to Peak Oil and Climate Change. *Journal of Urban Design*, 17, pp.301–303.

Chourabi, H. et al., 2011. Understanding smart cities: An integrative framework. In *Proceedings of the Annual Hawaii International Conference on System Sciences*. pp. 2289–2297.

References

Cloodt, M., 2013. Technology Entrepreneurship. , (November).

Deakin, M. & Al Waer, H., 2011. From intelligent to smart cities. *Intelligent Buildings International*, 3, pp.133–139.

Desouza, K.C. & Flanery, T.H., 2013. Designing, planning, and managing resilient cities: A conceptual framework. *Cities*, 35, pp.89–99.

Folke, C. et al., 2010. Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society*, 15.

Grontmij, 2015. Thuis in de stad , thuis in stedelijke gebiedsontwikkeling.

Hahn, H.A., 2013. The conundrum of verification and validation of social science-based models. *Procedia Computer Science*, 16, pp.878–887. Available at: http://dx.doi.org/10.1016/j.procs.2013.01.092.

De Innovator, 2015. Voorbeeld verdienmodel. Available at: http://de-innovator.nl/diensten/verdienmodel/voorbeeld-verdienmodel/ [Accessed June 10, 2015].

Komninos, N., Pallot, M. & Schaffers, H., 2013. Special Issue on Smart Cities and the Future Internet in Europe. *Journal of the Knowledge Economy*, 4, pp.119–134.

Kopp, F., 2015. A Literature Study on the Resilient Smart City Concept and Business Opportunities.

Lindgardt, Z. et al., 2009. Business Model Innovation: When the Game Gets Tough, Change the Game. *Boston Consulting Group*, (December), p.9.

Neirotti, P. et al., 2014. Current trends in smart city initiatives: Some stylised facts. *Cities*, 38, pp.25–36.

Rijksoverheid, 2015. Municipality tasks. Available at: http://www.rijksoverheid.nl/onderwerpen/gemeenten/taken-gemeente [Accessed June 4, 2015].

Thomas, G., 2011. A Typology for the Case Study in Social Science Following a Review of Definition, Discourse, and Structure. *Qualitative Inquiry*, 17(6), pp.511–521.

5 CONCLUSION

5.1 Goals and Results

This research set out to discover whether there was an opportunity for Engineering Firms to grasp Business Opportunities in the Resilient Smart City market, and what it would entail for said firms to do so. To answer these questions several aspects where covered. Firstly, and of prime importance, the question how the Resilient Smart City can actually be defined was discussed through an extensive literature review. Building a working definition was essential seeing as though the 'traditional' Smart City definition seems to have hit a dead-end, being used and adapted for whatever purpose authors required it. The Resilient City concept on the other hand, while very relevant, received far less attention possibly because it lacks the sex appeal the Smart City does have. Combining the two, that upon closer inspection are quit related, offers the chance to combine their prime advantages in a scientifically and societally relevant concept. Its definition that is quite specific but still open to interpretation on actual implementations reads as follows:

The Resilient Smart City is a city that empowers its Citizens to help it develop Efficiently and Sustainably through Resiliency Solutions.

The overall goal of the concept is to help cities remain livable now and in the future while being competitive and offering true value to their inhabitants .The second phase of the research focused on the question whether or not this definition could actually be translated into a BO for Engineering Firms and therefore implemented, to the benefit of both cities and said companies. To do so the concept of Business Model Innovation, a method to innovate both offered services and the way they are offered, was used as a research framework for a case study at Grontmij, investigating the innovation of the central aspects of the Business Model (Canvas) to come to a successful Business Strategy. The research was structured as a qualitative one, using explorative conversations, desk research and case-study projects for both theoretical input and verification and validation. In the process, the RSC definition was translated into a RSC Vision, paragraph 4.1, a proverbial dot on the horizon to strive for, a RSC Value Proposition, paragraph 4.2, concrete recommendations and strategies where suggested on the areas of Partners & Customers, Activities & Resources, the Value Proposition and the Revenue Model (Table 6), and a graphical model for grasping RSC Business Models was constructed to summarize both the research structure and the strategies (Figure 29 and Figure 30). All indications are that an entrepreneurial mindset is most essential and (in)directly related to most recommendations. The types of services suggested are new, both to the company and the marketplace so a pro-active attitude and the willingness to dive in an unknown market are of prime importance.

5.2 Relevance

The Resilient Smart City Concept, as it is defined in this research places the citizens needs in the center of urban projects by striving to empower them, and at the same time, in no small

part by doing this, it helps developing the city in a sustainable and efficient manner through resiliency solutions. This means the concept helps in some of the most important questions facing present-day cities: how to deal with major environmental issues; how to keep cities livable when they grow to extreme sizes, or alternatively shrink; how to involve and empower modern citizens in the processes so they can reach their own goals and reek the benefits and at the same time help realize solutions the shrinking government can or will not; etc. Even though the research originated from the stance of Business Opportunities for Engineering Firms, which might sound economically driven, it has strong societal relevance because this research indicates that Engineering Firms hold a key position in implementing Resilient Smart Solutions. Municipalities, communities and citizens cannot implement them on their own. As such, Business Opportunities are also Societal Opportunities.

One of the major advantages of looking at Business Opportunities is that by its very definition it pulled the RSC concept out of its theoretical environment of definition building and best practice case studies and into the world of practical, spatial applications. This is something that would seem quite important for something as physical as a city, but that is not often the focus in the theoretical scientific discourse. At the same time the Resilient Smart City definition and vision as defined in this research does add a new point of view on the issue of Smart Cities that is much more focused on goals and outcomes and much less on state of the art technical tools and solutions. In a striking paradox, the goal of this interest in practical implications served as a vehicle to further the scientific knowledge on RSC, because it delved into areas that as of present have been largely ignored.

The relevance for Grontmij of this paper is evident. As a research into Business Opportunities it attempted to define a strategy towards grasping new opportunities to become a prime player in a highly relevant marketplace and as such gain new projects and potential income. Even if the suggested strategies are not or only partially implemented the paper can be used as a critical reflection on the position of the Engineering Firm, its current practice and its relationship to the marketplace.

5.3 Discussion

Together the two papers that form the central body of this document were able to provide a refreshing concept that is aimed on actual urban qualities instead of trendy tools with potential to improve the quality of contemporary cities while at the same time offering BOs for Engineering Firms. The vision, strategies & recommendations and total model offer a practical toolbox to get started on RSC implementations that was at least partially verified and validated through literature research and a case study. There is certainly room for improvement and expansion on the subject. Prime areas of interest could be more in-depth research into sub-aspects of this broad research, specific quantitative research aimed at proven verification and validation, but especially the application of the suggested strategies in a real-world setting to test the theories suggested. In other words, it is time for Resilient Smart City Entrepreneurship.

REFERENCES

Al-Debei, M.M. & Avison, D., 2010. Developing a unified framework of the business model concept. *European Journal of Information Systems*, 19, pp.359–376.

Alawadhi, S. et al., 2012. Building understanding of smart city initiatives. In *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*. pp. 40–53.

Alkandari, A. & Alshekhly, I.F.T., 2012. Smart Cities : Survey. *Journal of Advanced Computer Science and Technology Research*, 2(2), pp.79–90.

Allwinkle, S. & Cruickshank, P., 2011. Creating Smart-er Cities: An Overview. *Journal of Urban Technology*, 18, pp.1–16.

Alvarez, S.A. & Barney, J.B., 2007. Discovery and creation: alternative theories of entrepreneurial action. *Strategic Entrepreneurship Journal*, 1, pp.11–26. Available at: http://doi.wiley.com/10.1002/sej.4.

Amit, R. & Zott, C., 2012. Creating Value Through Business Model Innovation. *MIT Sloan Management Review*. Available at: http://sloanreview.mit.edu/article/creating-value-through-business-model-innovation/.

Amsterdam Smart CIty, 2011. Amsterdam Smart City. *URENIO Research Unit*. Available at: http://www.urenio.org/2011/04/20/amsterdam-smart-city-smart-stories-2011/.

Andersson, S., 2015. The Urban as a Resilient System of Processes. *Topos - The International Review of Landscape Architecture and Urban Design*, pp.22–29.

Antrobus, D., 2011. Smart green cities: from modernization to resilience? *Urban Research & Practice*, 4, pp.207–214.

Bach, B., Wilhelmer, D. & Palensky, P., 2010. Smart buildings, smart cities and governing innovation in the new millennium. In *IEEE International Conference on Industrial Informatics (INDIN)*. pp. 8–14.

Bakici, T., Almirall, E. & Wareham, J., 2013. A Smart City Initiative: The Case of Barcelona. *Journal of the Knowledge Economy*, 4(January 2012), pp.135–148.

Bătăgan, L., 2011. Smart Cities and Sustainability Models. *Revista de Informatică Economică*, 15, pp.80–87. Available at: http://revistaie.ase.ro/content/59/07 - Batagan.pdf.

Batty, M. et al., 2012. Smart cities of the future. *European Physical Journal: Special Topics*, 214, pp.481–518.

References

Bélissent, J., 2010. Getting clever about smart cities: new opportunities require new business models. *Forrester Research, inc*, p.33. Available at: http://groups.open.org.nz/groups/ninja-talk/files/f/19710-2010-11-04T092134Z/getting_clever_about_smart_cities_new_opportunities.pdf.

Board of Innovation, 2015. index @ www.boardofinnovation.com. Available at: http://www.boardofinnovation.com/ [Accessed March 20, 2015].

Byers, T. H., Dorf, R. C., Nelson, a. J., 2011. *Technology Venture from Idea to Enterprise*,

Caragliu, A., Del Bo, C. & Nijkamp, P., 2011. Smart Cities in Europe. *Journal of Urban Technology*, 18, pp.65–82.

Centre of Regional Science Vienna UT, 2007. *Smart cities Ranking of European medium-sized cities*, Available at: http://linkinghub.elsevier.com/retrieve/pii/S026427519800050X.

Chapman, R., 2012. Resilient Cities: Responding to Peak Oil and Climate Change. *Journal of Urban Design*, 17, pp.301–303.

Chen, T., 2010. Smart grids, smart cities need better networks. *IEEE Network*, 24, pp.2–3.

Chourabi, H. et al., 2011. Understanding smart cities: An integrative framework. In *Proceedings of the Annual Hawaii International Conference on System Sciences*. pp. 2289–2297.

Chourabi, H. et al., 2012. Understanding Smart Cities: An Integrative Framework. *2012 45th Hawaii International Conference on System Sciences*, pp.2289–2297. Available at: http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=6149291 [Accessed July 10, 2014].

Cloodt, M., 2013. Technology Entrepreneurship. , (November).

Cork, S., 2010. Resilient Cities. In *Resilience and Transformation: Preparing Australia for Uncertain Futures*. pp. 5–22.

Cosgrave, E., Arbuthnot, K. & Tryfonas, T., 2013. Living labs, innovation districts and information marketplaces: A systems approach for smart cities. In *Procedia Computer Science*. pp. 668–677.

Deakin, M. & Al Waer, H., 2011. From intelligent to smart cities. *Intelligent Buildings International*, 3, pp.133–139.

Department for Business Innovation and Skills, 2013. *The Smart City Market: Opportunities for the UK*,

Desouza, K.C. & Flanery, T.H., 2013. Designing, planning, and managing resilient cities: A conceptual framework. *Cities*, 35, pp.89–99.

References

Drevel, J., Visser, W. & Jonge, M. de., 2012. Zelf verantwoordelijk voor kavel en omgeving. *Land+Water*, (6). Available at: http://www.grontmij.nl/MediaCenter/Nieuwsarchief/Documents/Zelf verantwoordelijk voor kavel en omgeving.pdf.

European Union, R.P., 2011. *Cities of Tomorrow. Challenges, visions, ways Forward*, Available at: http://discovery.ucl.ac.uk/111079/.

Folke, C. et al., 2010. Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society*, 15.

Grontmij, 2015a. Diensten @ www.grontmij.nl. Available at: http://www.grontmij.nl/diensten/Pages/Diensten.aspx [Accessed March 20, 2015].

Grontmij, 2015b. RuimtevoorRuimte. Available at: http://www.grontmij.nl/Projecten/Pages/RuimtevoorRuimte.aspx.

Grontmij, 2015c. Thuis in de stad , thuis in stedelijke gebiedsontwikkeling.

Hahn, H.A., 2013. The conundrum of verification and validation of social science-based models. *Procedia Computer Science*, 16, pp.878–887. Available at: http://dx.doi.org/10.1016/j.procs.2013.01.092.

Hancke, G.P., de Silva, B. de C. & Hancke, G.P., 2013. The role of advanced sensing in smart cities. *Sensors (Switzerland)*, 13, pp.393–425.

Harrison, C. et al., 2010. Foundations for Smarter Cities. *IBM Journal of Research and Development*, 54, pp.1–16.

Harrison, C. & Donnelly, I., 2011. A theory of smart cities. In *Proceedings of the 55th Annual Meeting of the ISSS*. pp. 1–15. Available at: http://journals.isss.org/index.php/proceedings55th/article/view/1703.

Hordijk, M. & Baud, I., 2011. Resilient Cities. *Media*, pp.111–121. Available at: http://www.springerlink.com/index/10.1007/978-94-007-0785-6.

De Innovator, 2015. Voorbeeld verdienmodel. Available at: http://de-innovator.nl/diensten/verdienmodel/voorbeeld-verdienmodel/ [Accessed June 10, 2015].

Komninos, N., Pallot, M. & Schaffers, H., 2013. Special Issue on Smart Cities and the Future Internet in Europe. *Journal of the Knowledge Economy*, 4, pp.119–134.

Kopp, F., 2015. A Literature Study on the Resilient Smart City Concept and Business Opportunities.

Kourtit, K. & Nijkamp, P., 2012. Smart cities in the innovation age. *Innovation: The European Journal of Social Science Research*, 25, pp.93–95.

Lee, J.H., Phaal, R. & Lee, S.H., 2013. An integrated service-device-technology roadmap for smart city development. *Technological Forecasting and Social Change*, 80, pp.286–306.

Leydesdorff, L. & Deakin, M., 2011. The Triple-Helix Model of Smart Cities: A Neo-Evolutionary Perspective. *Journal of Urban Technology*, 18, pp.53–63.

Lindgardt, Z. et al., 2009. Business Model Innovation: When the Game Gets Tough, Change the Game. *Boston Consulting Group*, (December), p.9.

Maslow, A.H., 1969. The farther reaches of human nature. *Journal of Transpersonal Psychology*, 1(1), pp.1–9.

Murray, J. & King, D., 2012. Climate policy: Oil's tipping point has passed. *Nature*, 481, pp.433–435.

Nam, T. & Pardo, T.A., 2011. Conceptualizing smart city with dimensions of technology, people, and institutions. In *Proceedings of the 12th Annual International Digital Government Research Conference on Digital Government Innovation in Challenging Times - dg.o '11*. p. 282. Available at: http://dl.acm.org/citation.cfm?id=2037556.2037602\nhttp://dl.acm.org/citation.cfm?id=2072069.2072100\nhttp://dl.acm.org/citation.cfm?doid=2037556.2037602.

Neirotti, P. et al., 2014. Current trends in smart city initiatives: Some stylised facts. *Cities*, 38, pp.25–36.

Nicolaas Participaties, 2015. www.nicolaasparticipaties.nl. Available at: http://www.nicolaasparticipaties.nl/ [Accessed May 19, 2015].

Oberdorf, J., 2012. *Private housing within reach*.

Platform 31, 2003. Rol-gemeente-in-stedelijke-vernieuwing-sterk-veranderd @ kennisbank.platform31.nl. Available at: http://kennisbank.platform31.nl/pages/10284/Nieuws/Rol-gemeente-in-stedelijke-vernieuwing-sterk-veranderd.html [Accessed March 15, 2015].

Rijksoverheid, 2015a. Municipality tasks. Available at: http://www.rijksoverheid.nl/onderwerpen/gemeenten/taken-gemeente [Accessed June 4, 2015].

Rijksoverheid, 2015b. woningcorporaties @ www.rijksoverheid.nl. Available at: http://www.rijksoverheid.nl/onderwerpen/woningcorporaties [Accessed March 20, 2015].

Schaffers, H., Ratti, C. & Komninos, N., 2012. Special issue on smart applications for smart cities - new approaches to innovation: Guest editors' introduction. *Journal of Theoretical and Applied Electronic Commerce Research*, 7.

References

Singh, S., 2014. Smart Cities - A 1.5 Trillion dollar Market Opportunity. Available at: http://www.forbes.com/sites/sarwantsingh/2014/06/19/smart-cities-a-1-5-trillion-market-opportunity/.

Smart Directions, Smart Cities Reference Diagram. Available at: www.smartdirections.info/cities [Accessed February 12, 2015].

Thomas, G., 2011. A Typology for the Case Study in Social Science Following a Review of Definition, Discourse, and Structure. *Qualitative Inquiry*, 17(6), pp.511–521.

Winters, J. V., 2011. Why are smart cities growing? who moves and who stays. *Journal of Regional Science*, 51, pp.253–270.

APPENDICES

Appendix 1: Additional thoughts on RSC Business Strategy

This appendix provides some additional thoughts on the relationship between theoretical business strategy and RSC services. It is not key to the structure of the central research but worth discussing anyway.

A Business Model, and especially an Innovated Business Model, is of course closely related to the chosen market strategy. The two should form a synthesis. Resilient Smart City services are aimed at a changing marketplace indicating an Entrepreneurial mindset and strategy, and on the new creation of value, as opposed to a stable marketplace and the capturing of value. As such, a winning strategy in the RSC market should be a Resource Enrichment Strategy. (Byers, T. H., Dorf, R. C., Nelson 2011) (Cloodt 2013)

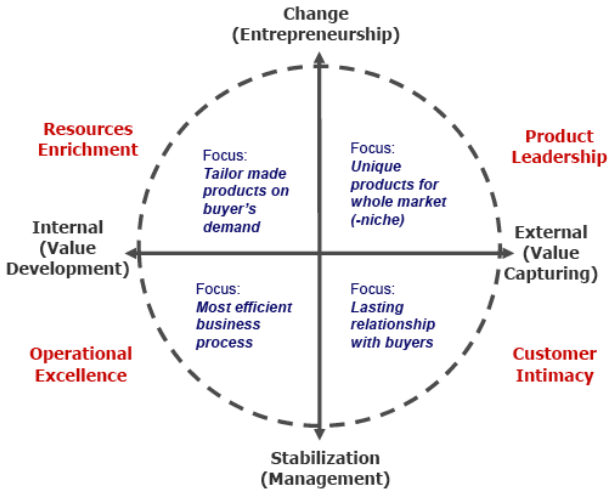


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Figure 31 Strategy

As opposed to Product Leadership strategies, that primarily require Intellectual Assets, a Resource Enrichment Strategy also requires strong Socialization and Commercial Assets. (Cloodt 2013)This closely matches idea of Innovating both the Value Proposition (Intellectual) and the Structure of Activities (Socialization, Commercial).

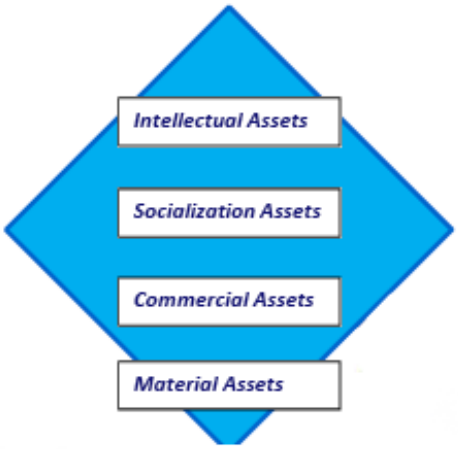


Figure 32 Assets for Resource Enrichment

Appendix 2 Key Partners and Customers - Stakeholder Analysis

This appendix describes an extensive stakeholder analysis on the RSC marketplace in its present form, the way it will change and its future form. It serves as a major input for paragraph 3.2 Key Partners and Customers - How to approach the Market.

Appendix 2.1: Stakeholder Analysis for the present RSC Marketplace

Engineering Firms

Engineering Firms are companies that have experts in house on all sorts of engineering questions, and sell their services to customers that lack the specific knowledge. The services they can provide are on a very wide range of technical subjects. Even within the field of Urban Development, which is just a small part of possible working areas for Engineering Firms, there is a wide scope of different forms of expertise.

To give an example, Grontmij offers services in Soil & Ground, Building & Real Estate, Energy, Finance, Industry, Infrastructure & Mobility, Environment, Urban Development, Water, etc., and each of these areas divided up even further. A popular saying within the company reads something like: *Look outside, everything you see we can engineer!* (Grontmij 2015a)

When related to the other stakeholders, the Engineering Firm is virtually always a service provider. It sells its expertise to answer customers' questions. Because of its highly specialized knowledge customers are mostly those with complex problems.

By and large, and there are certainly exceptions, an engineering firm by its definition will act re-actively. It is challenged by a customer to solve a problem, and it does so.

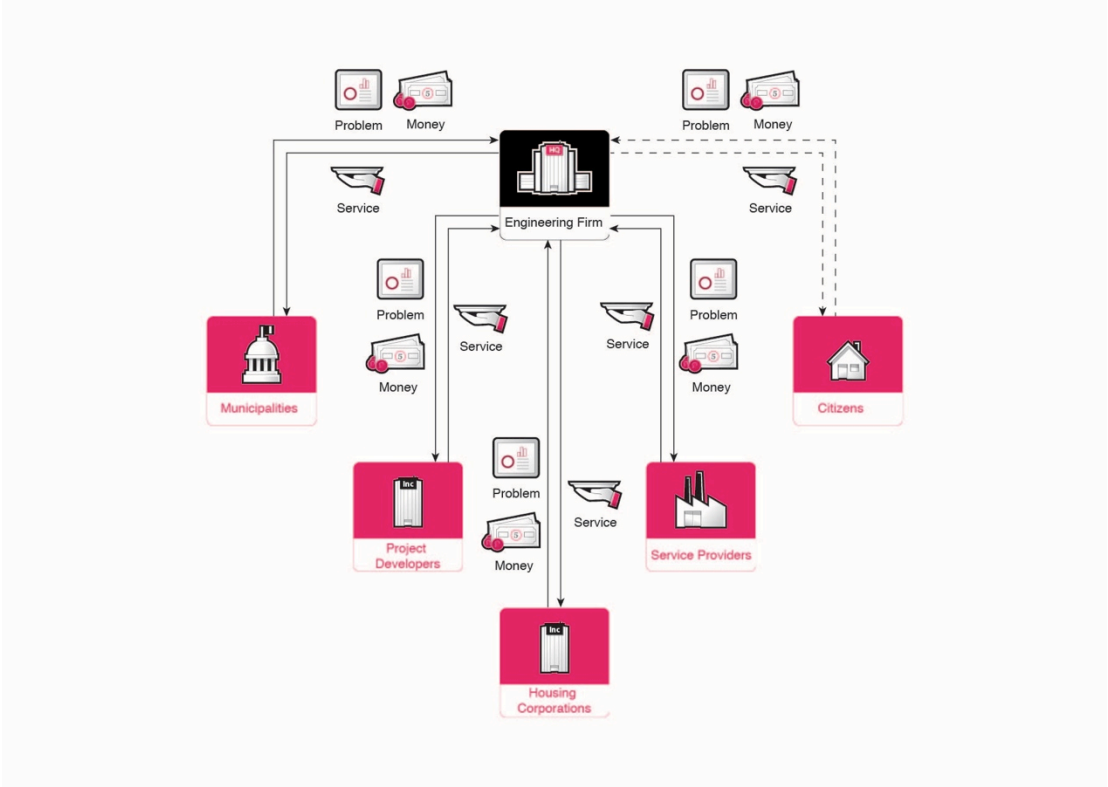


Figure 33 Stakeholder Relationships for Engineering Firms

Municipalities

The primary goal of the municipality is to guard the public interest. In the field of Urban Development it does so mainly through a directing role. It is focused on steering spatial development by considering interest of all parties involved as well as the public interest. Among other ways this is done through the Structuurvisie - a document on spatial policy - and Bestemmingsplannen - land-use plans - and land allocation. (Oberdorf 2012)

Through the years the role of the municipality has changed considerably. Whereas municipalities used to be able to act quite autonomously, for different reasons mainly focused around privatization and budget cuts, presently they are heavily reliant on the market for spatial development. They can steer through policy development and the tools mentioned above, but for actual development they rely largely on the project developers and housing corporations. (Platform 31 2003)

For all stakeholders involved municipalities are the regulatory body. Traditionally in the Netherlands they are quite heavily involved in urban development. For Engineering Firms they are customers, interested in a very wide field of services related to their physical form and planning that are (no longer) their core business or they lack the expertise in.

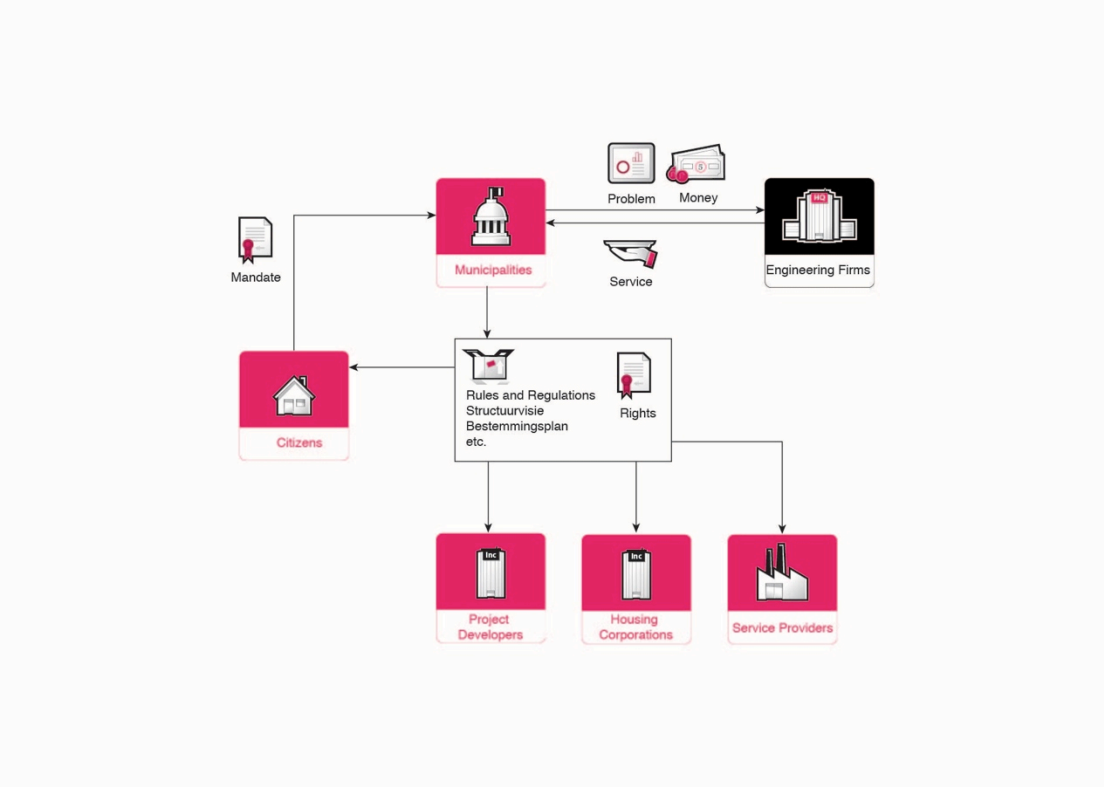


Figure 34 Stakeholder Relationships for Municipalities

Housing Corporations

Housing Corporations in the Netherlands build, manage and let affordable housing. Next to this they undertake activities to increase the livability in neighborhoods where their real estate is located. They do so on a non-profit basis and are assigned their tasks by the Dutch Central Government through law. About two thirds of all Dutch tenement housing is owned by housing corporations which makes them a very large player. (Rijksoverheid 2015b)

Interestingly, one of the goals they have been set by government is to stimulate private house ownership by selling parts of their housing stock. This is because the government believes that privately owned homes result in social benefits, such as more respect for the surrounding neighborhood, more social involvement, etc. (Rijksoverheid 2015b)

Housing Corporations are primarily customers for Engineering Firms, that are sold technical solutions for maintenance. Grontmij is also involved in Real Estate Management. (Grontmij 2015a)

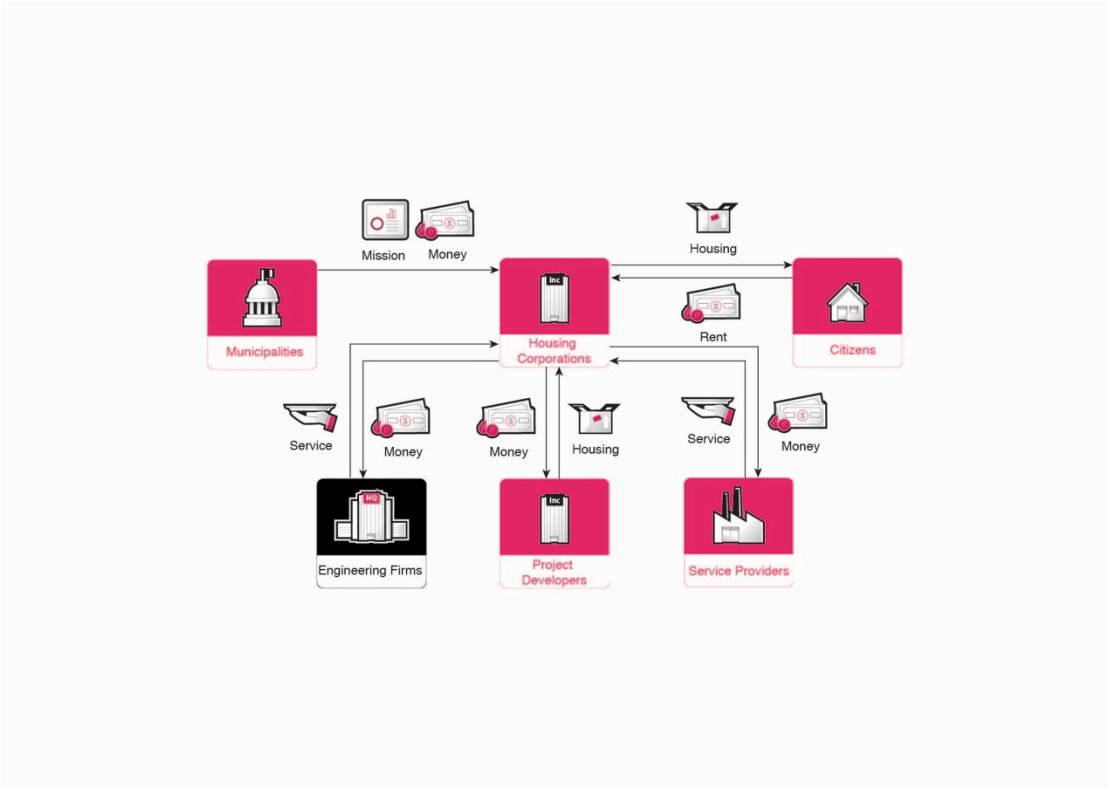


Figure 35 Stakeholder Relationships for Housing Corporations

Citizens

Actual citizens can be seen as the end users of urban development projects, or in fact the city itself. Their interests are a combination of all services provided by the city. They require shelter, water, food, heat, energy, work, recreation, etc. They expect a healthy and pleasant environment, at an affordable price and influence on their living situations.

Citizens are the pivot point around which all the other stakeholders gravitate. All the services provided by a city are there to suit their needs. The municipality is there to guard their interest and govern them, but is also democratically chosen by them - at least in the Netherlands. Project developers build there products with the aim to sell them to citizens. Housing corporations where created to suit the housing needs of those citizens that cannot afford decent housing otherwise. Service providers provide all the services that are needed to live comfortably in a city.

In the present day situation, at least in the Netherlands, most of the dwelling needs of citizens are handled by governments and companies or comparable institutions. There is certainly private housing development in the Netherlands, and there are experiments in Collective Building, but these form a comparatively small part of the market. Citizens have largely delegated services including their housing needs to the mentioned institutions. This is one of the reasons Engineering Firms seldom cater to citizens directly, as well as the fact that private housing production is highly regulated and almost always takes the form of quite standard developments.

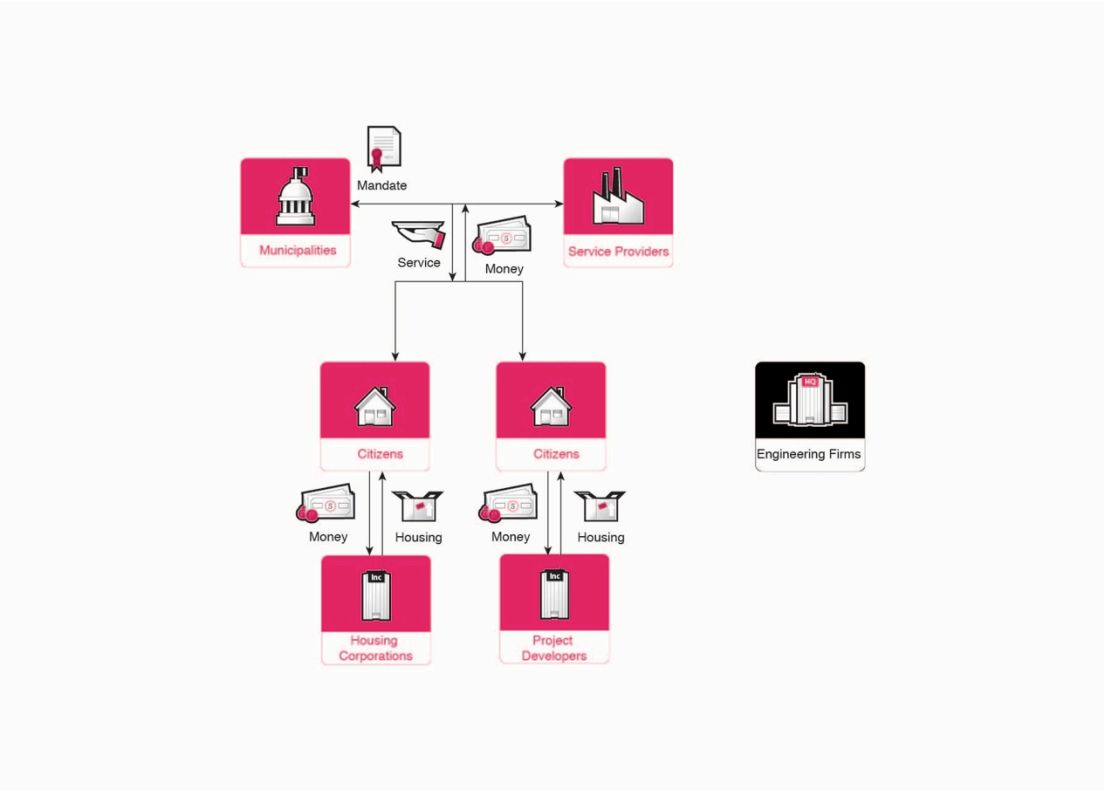


Figure 36 Stakeholder Relationships for Citizens

Project Developers

Project developers develop market-oriented real estate concepts. They operate based upon risk and for them return on investment is leading. Profits from development are used for company continuity and shareholder dividends. Project Developers are involved from an early stage in the Urban Development process. They look for business opportunities provided by market demands, available land to develop and government influence through zoning plans, etc. They are involved in draft design activities and the feasibility of projects is judged based on financial, urban, social and market-oriented aspects. Their production consist largely of private housing, sold to individual citizens, and tenement housing, sold to corporations. (Oberdorf 2012)

For the last few years project developers have been having a hard time developing new project due to the economic downturn.

For Engineering Firms project developers are primarily customers that are sold services in technical or design related areas for their urban development projects. Grontmij is also involved in Real Estate Management. (Grontmij 2015a)

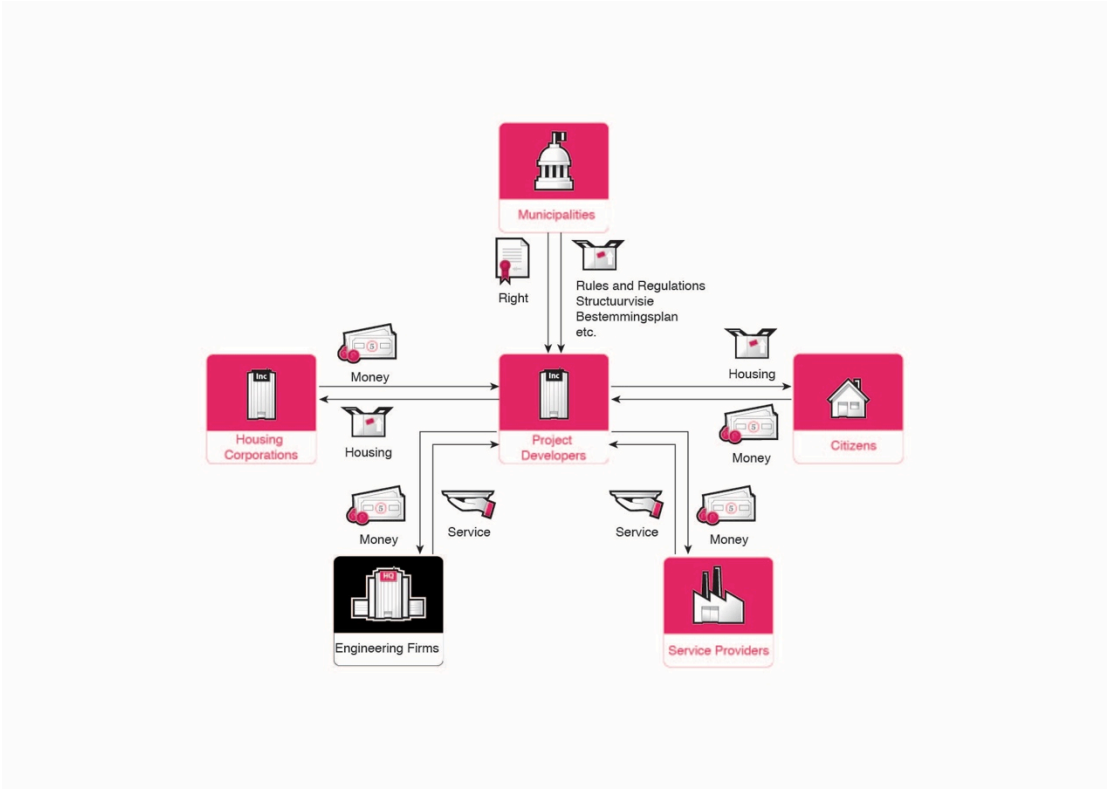


Figure 37 Stakeholder Relationships for Project Developers

Service Providers

Grouped together under the phrase Service Providers are the companies that provide the different services required for the functioning of households. They include the energy providers, the water providers, gas providers, in some case heat providers, garbage disposal services, etc. Usually they are vendors of their products to individual households, but they can also sell their products to for instance housing corporations at large.

Through innovations like solar panels in some cases service providers are actually becoming customers themselves for energy from consumers, but this is highly regulated and still in a very premature stage.

Service providers can be customers for Engineering Firms. For instance, Grontmij targets energy providers and telecom companies for technical solutions. (Grontmij 2015a)

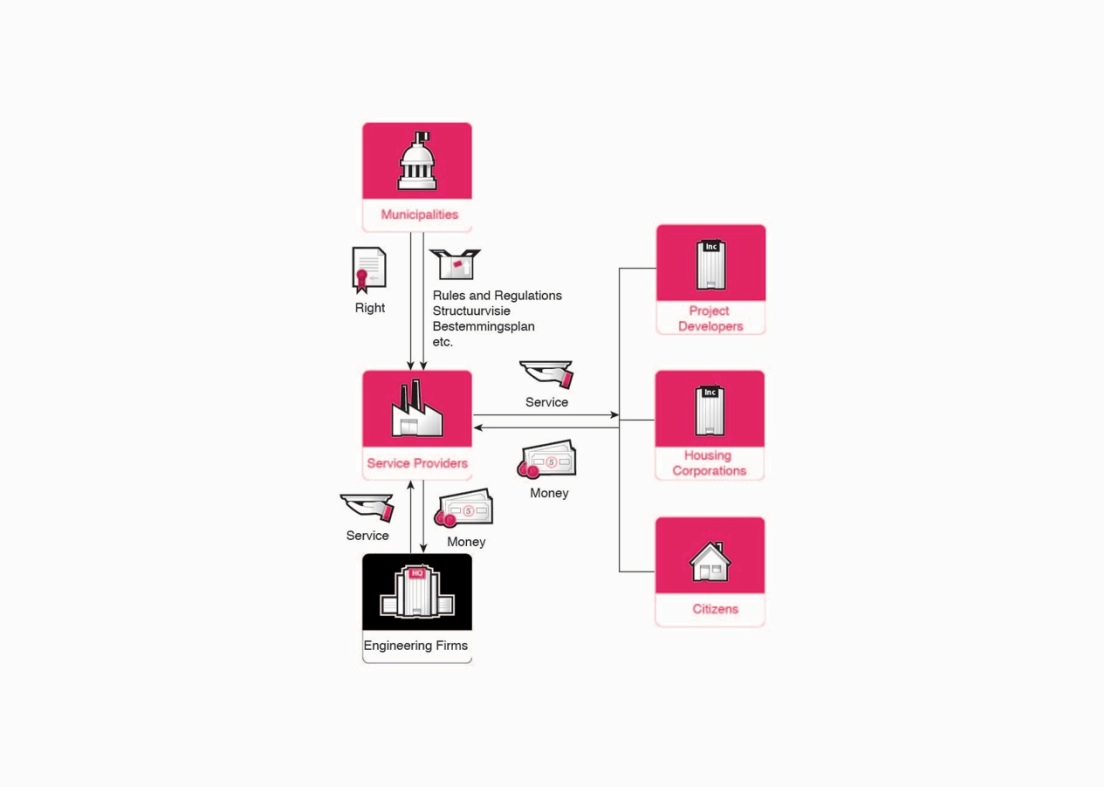


Figure 38 Stakeholder Relationships for Service Providers

Appendix 2.2: Stakeholder Analysis - Changing Roles and Requirements

Municipalities

The role of municipalities was already a steering one, and will remain so. Firstly, municipalities are in control of the development of their public works, the top-down aspect of RSC solutions. For future development they should steer towards resilient solutions in this area. It might very well be that these solutions will cost more in the short term at the benefit of a lower long-term cost of ownership This requires political will, but also proof of the perceived long-term benefits.

Although housing area development (as well as other areas) towards Resilient solutions are largely a bottom-up process, and they should be, municipalities can help their implementation through their planning powers. For some developments they might also need to adapt building rules and regulations.

The present national government has plans to give municipalities direct control over Housing Corporations, this would increase their influence further. (Rijksoverheid 2015b)

Importantly, to be able to adapt their present role, municipalities need to be aware of the need for RSC aspects and possible solutions, and willing to adapt them, despite shrinking budgets. The arguments to do so are clear.

Housing Corporations

Next to the building en letting of social-dwellings Housing Corporations have been given more responsibilities by government. These include activities to heighten the livability in the neighborhoods where there housing is located and to stimulate private home ownership by selling their stock. Both these areas would benefit from RSC solutions. (Rijksoverheid 2015b)

On a more general level, housing corporations are strongly situated at the meso-level where many RSC solutions could have a strong impact, as seen in Figure 14 A RSC Scenario. Because of this, by striving towards RSC solutions Housing Corporations could have a large impact, specifically for a vulnerable group of citizens that would have trouble to implement RSC solutions themselves. By choosing RSC solutions their neighborhoods would become more self-reliant and as such improve and empower their inhabitants housing situation.

Together, these arguments encourage Housing Corporations to act. The fact that municipalities stand to gain more influence on their behavior could strengthen their willingness, assuming the municipalities are interested in acting. Constant pressure on their budgets and a political emphasis on focusing on core-activities however threaten their likelihood of acting. Overall, their strategy is heavily influenced by political forces.

Project Developers

Project Developers play a pivotal role in constructing the Dutch cityscape. Their need for RSC solutions can come from several angles. Firstly, they build a considerable part of their stock for Housing Corporations, so like described in the previous paragraphs a will at municipality level to realize RSC solutions will automatically result in Project Developer will.

More generally and in a reactive sense, a municipal will towards the RSC will likely result in a Spatial Planning policy that is geared towards RSC implementations.

In the present market, that is still very tight, commercial developments meant for the open market are strongly demand driven, as opposed to the situation of times past where it was supply-driven. (Oberdorf 2012) This implies that Project Developers are going to build what their consumers, the citizens, are asking for. Again, this is a reactive way of thinking. Project Developers, through their profit based strategy, will build what the market demands from them.

Citizens

The citizen is most likely the stakeholder whose position will change the most in a RSC marketplace. The ideal RSC citizen is actively involved in RSC solutions, because he is devoted to their own empowerment as well as a sustainable and livable city. They are involved in the lowest level of decentralization of city systems, that of the individual household. Alternatively, as neighborhood communities they could form collective associations to hand RSC solutions on a meso-level, without being reliant on major corporations, foreign oil reserves, etc.

This ideal image is partly true for a small group of avant-garde citizens. However, the average citizen is not that interested in these issues, at least not consciously. They are mainly interested in a pleasant environment, convenience and economic considerations.

At the same time the citizen is probably the most important stakeholder for a RSC. The RSC focuses on their needs. They have the power not only to implement solutions on their own, but also to influence Municipality behavior as well as that of Project Developers. Together, this means that to have a hope of implementing RSC solutions, especially the all-important bottom-up ones, the citizen will need to be convinced. To convince the citizen he will need to be informed on the need for, and possibilities of, RSC, and specifically, these aspects need to be closely tied to their conscious personal needs, of a pleasant environment, convenience and economic considerations.

In an interesting paradox, such a course of action through basic conscious needs will help citizens in realizing higher level subconscious needs as discussed in Maslow's Hierarchy of Needs.

Service Providers

For Service Providers the RSC is partially a threat. Companies like Energy Provider stand to gain competition from individual household and neighborhoods. To cope with this they might need to change their strategy, towards providing services that help implement RSC solutions such as Smart Grids. As such, they will need to adapt to remain relevant.

In the short term, depending on technical solutions they might need to be involved in changing systems in existing areas. At the very least in a very negative sense, municipalities and higher-level governments must not allow them to become an obstruction towards the RSC.

Engineering Firms - Conclusion

Finally, what does this all mean for the Engineering Firms? In their role as advisors they are already able to sell services to all other stakeholders in the Urban Development market, in virtually all domains. Through their broad expertise they poses all the required knowledge to help implement RSC solutions, or are easily able to acquire this knowledge.

However, present practice shows that this combination of a decent market position and all the required knowledge has not proven to be sufficient to result in a strong RSC Business Opportunity. The analysis of the changing roles and requirements for the most important stakeholders that a changing RSC Marketplace scenario implies in the previous paragraphs provides an indication of potential pitfalls.

- Municipalities should theoretically be interested customers, but are not necessarily knowledgeable on the subject.
- Housing Corporations primarily stick to their core business, which does not include RSC solutions in an obvious fashion
- Project Developers tend to build what the market demands, especially in a tight market, and through a variety of reasons the market does not demand RSC implementations
- Citizens are the most important stakeholder towards the RSC, however they are not often knowledgeable on the subject and its implementations, despite the fact it stands to benefit them. Added to this, they often don't see a clear link between RSC solutions and their immediate needs.

Appendix 2.3: Stakeholder Relationships for Engineering Firms in the future RSC Marketplace

Positioning as The RSC Specialist

First of all, to be able to approach the market as a RSC specialist, an Engineering Firm should communicate that it is one. A clear message on what they think the importance of the concept is and what contribution they can offer should be formulated and communicated through a marketing strategy. Such a message could be based upon the RSC definition formulated in paragraph 2.7 Defining the Resilient Smart City.

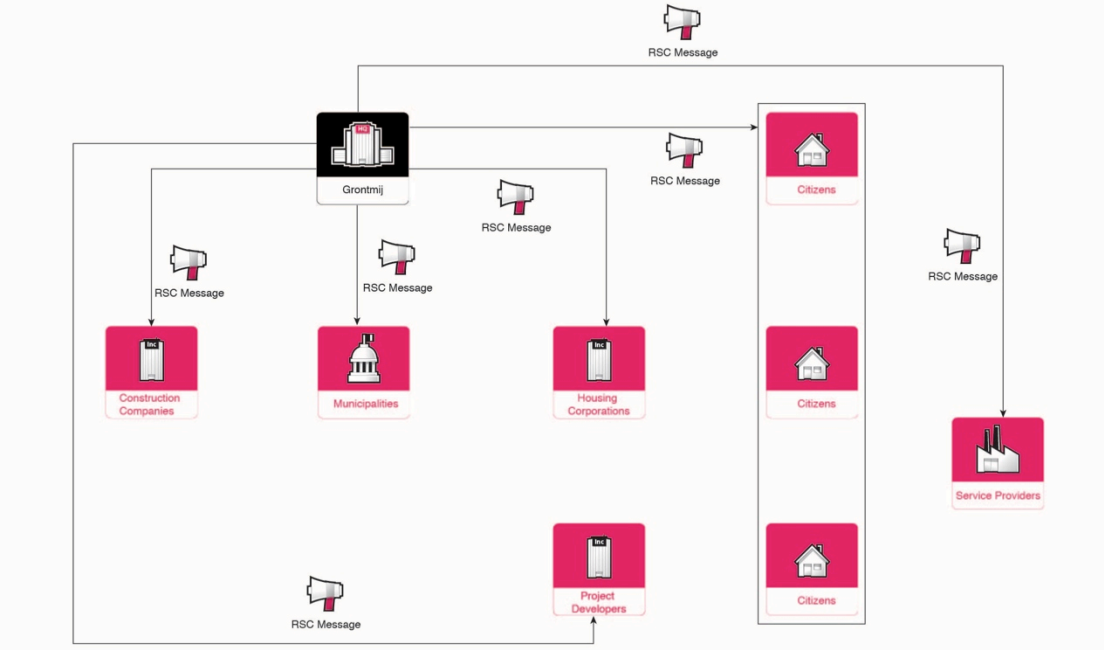


Figure 39 Positioning as a RSC Specialist

Pro-Actively Approaching the Municipality

Despite their shrinking budgets and less active role in Urban Development Municipalities are still prime players in the market, and will certainly remain so in a RSC scenario. Through their direct role in Public Works and their steering role in other developments it will become clear that convincing them to get involved is of prime importance to implement RSC solutions.

Like discussed in previous chapters, the main problem of getting Municipalities involved is their lack of knowledge, or at least expertise, on the concept, partially because it is (no longer) their core task. This has two major impacts. Firstly, they might not know why the concept is important for them, so they will not perceive a need for RSC implementations. Secondly, they don't have the in house knowledge to implement solutions themselves.

For Engineering Firms this provides a strong opportunity to provide services the Municipality cannot handle in-house. However the situation also implies that their lies a responsibility with the Engineering Firm to educate, for lack of a better phrase, the Municipality of the importance of the RSC, and the possibilities involved. In effect, they have to create their own assignments, by informing and as such creating need. This implies a shift from acting passively to pro-actively.

Ideally, through this process RSC thinking will become part of the Municipalities Spatial Planning Documents. This first step is of prime importance to gain further Business Opportunities, as will become clear in the following paragraphs.

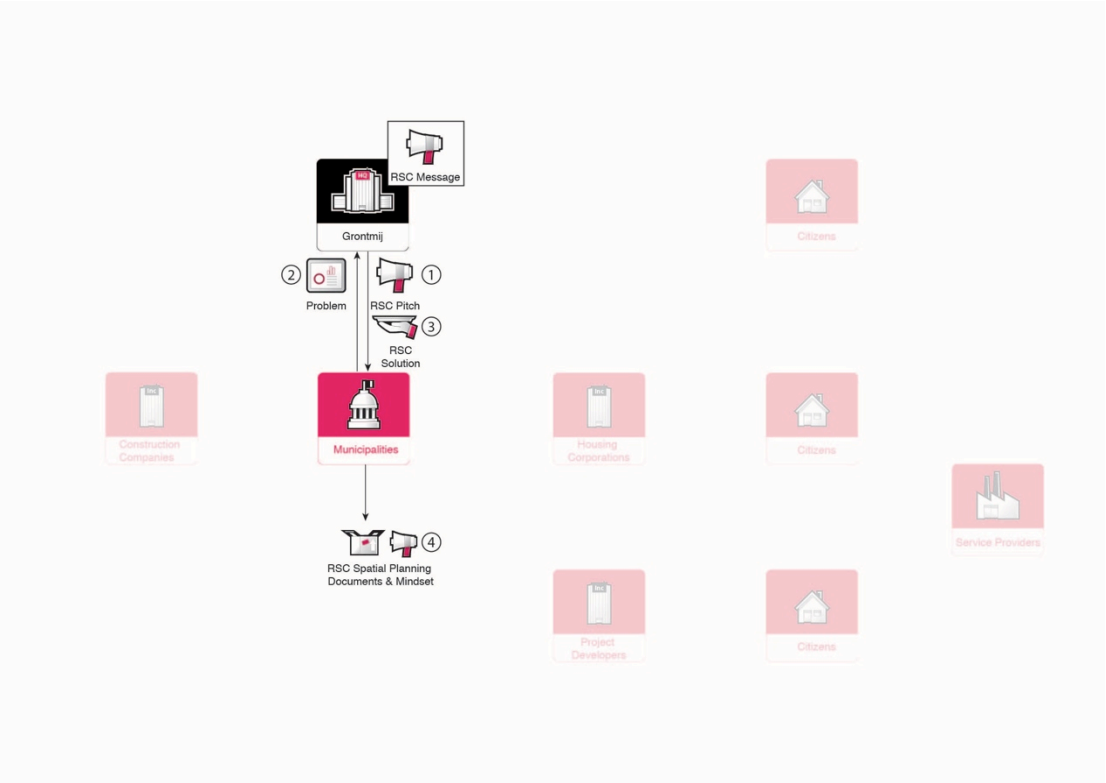


Figure 40 Approaching Municipalities Pro-Actively

RSC Public Works

By having involved and convinced the Municipality in RSC goals, urban projects on the Macro-level, will be much more likely to be based upon RSC thinking through direct pressure of the Municipality and its Spatial Planning Documents.

Here a second Business Opportunity arises by being able to sell RSC solutions to Construction companies contracted to construct Public Works, at least in so far they do not have all the knowledge in-house to do so, a situation that is highly likely, because of the newness of the RSC market that has been holding it back so far.

To gain this Business Opportunity the Engineering Firm will not need to undertake any more action it normally would not. It is founded one their positioning as the RSC specialist and the effort put into involving the Municipality earlier on.

Of course, in practice this process will not be as easy as suggested here, but the basic line of reasoning is sound.

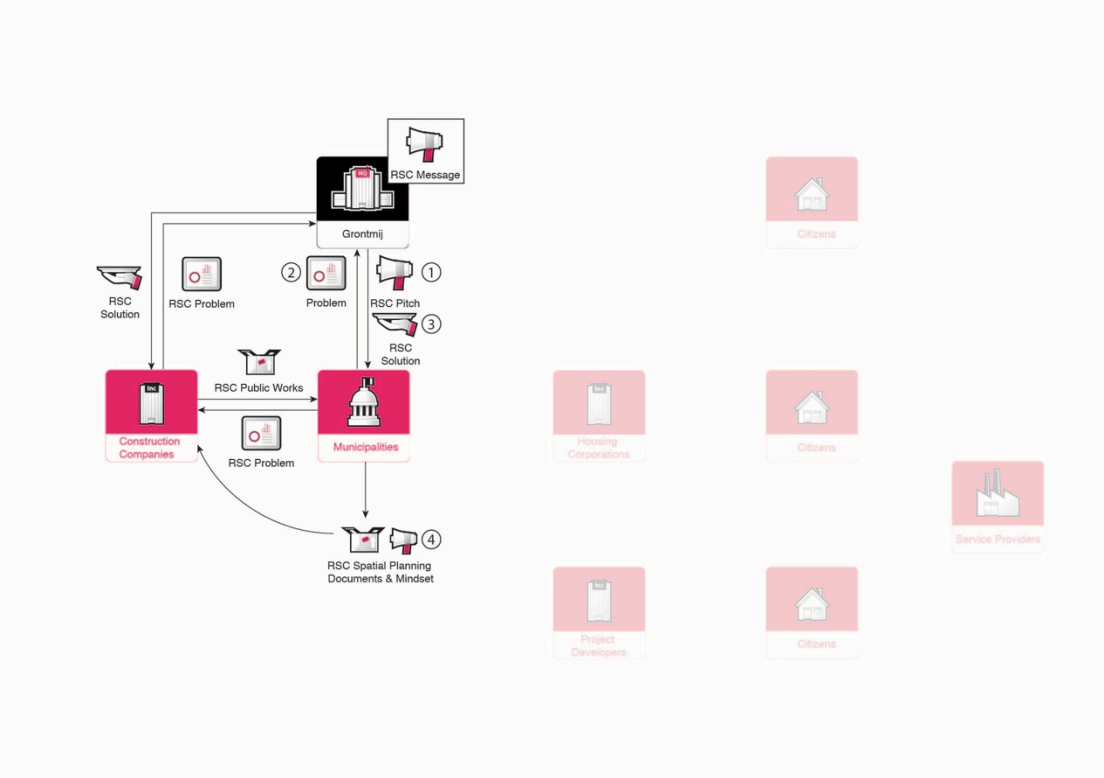


Figure 41 RSC Public Works

RSC Social Housing

In a comparable manner to the Public Works strides can be made towards implementing RSC solutions in Public Housing projects and gaining a RSC Business Opportunity in this market segment

Seeing as though the Municipality has, or at least will have in the near future, direct influence on the acting of Housing Corporations, convincing them will dramatically increase the chances of RSC implementations in the Social Housing Stock. Here the municipality actually has strong influence on the development of projects. If Housing Associations decide to implement RSC solutions, this implies two new RSC Business Opportunities for the Engineering Firm. Firstly, the Associations will most likely lack in-house knowledge on the issue and therefore can be sold RSC solutions. Secondly, for so far they contract Project Developers to construct their housing stock, these stakeholders will also become a potential customer for at least part of their business, for the same reasons.

In such a way, two new stakeholders can become potential RSC customers, without any real additional efforts. The work was already done in earlier phases. The same caveat as in the previous paragraph on practical complications applies.

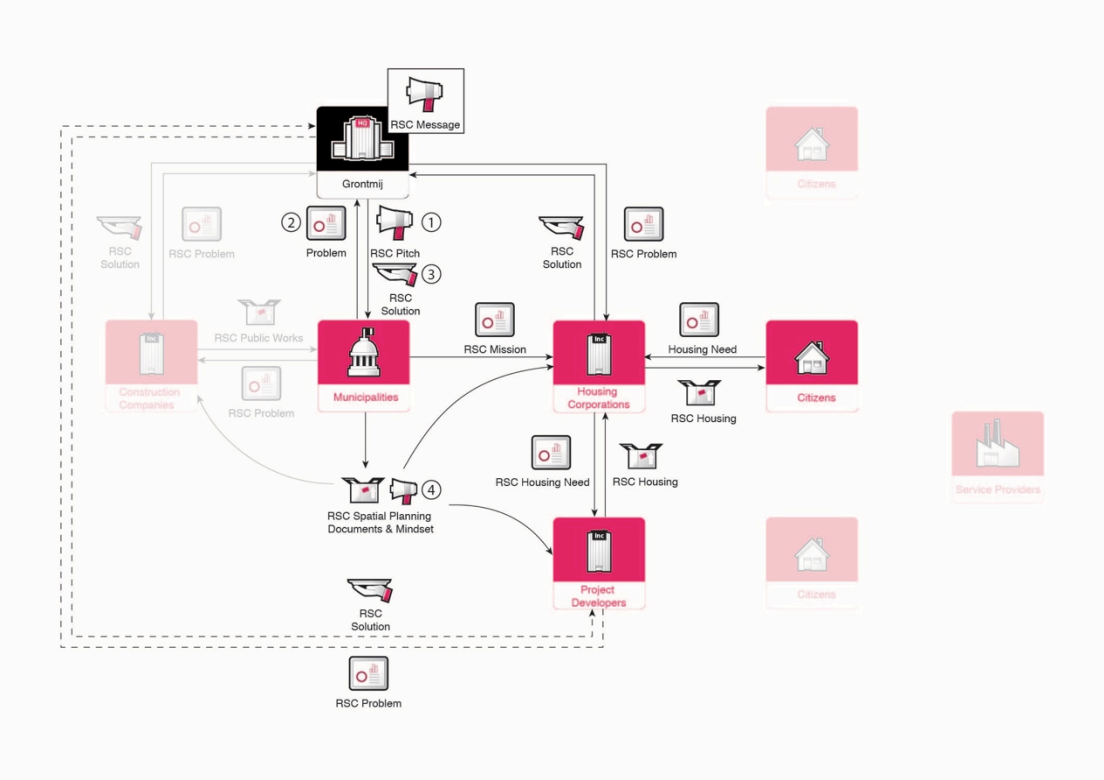


Figure 42 RSC Social Housing

Initial interest Citizens RSC Private Housing

A final effect of actively involving municipalities in RSC initiatives can be that an initial interest in these initiatives can be awakened among the most important stakeholders, the citizens. Through RSC elements in its Spatial Planning Documents Municipalities might already consciously influence private housing initiatives and Project Developer projects.

Also, previously mentioned Housing Corporation projects could act as proof of concept and frontrunner projects. It is likely that both private developers and Project Developers will not want to be left behind in new initiatives once they perceive the benefits, both financially and in terms of environmental issues, whether or not the interest in this last aspect is actual or from an image point of view.

This can result in Business Opportunities for Engineering Firms towards private citizens and Project Developers, but primarily it is important that the RSC is planted in the environments, and therefore minds, of the Citizens.

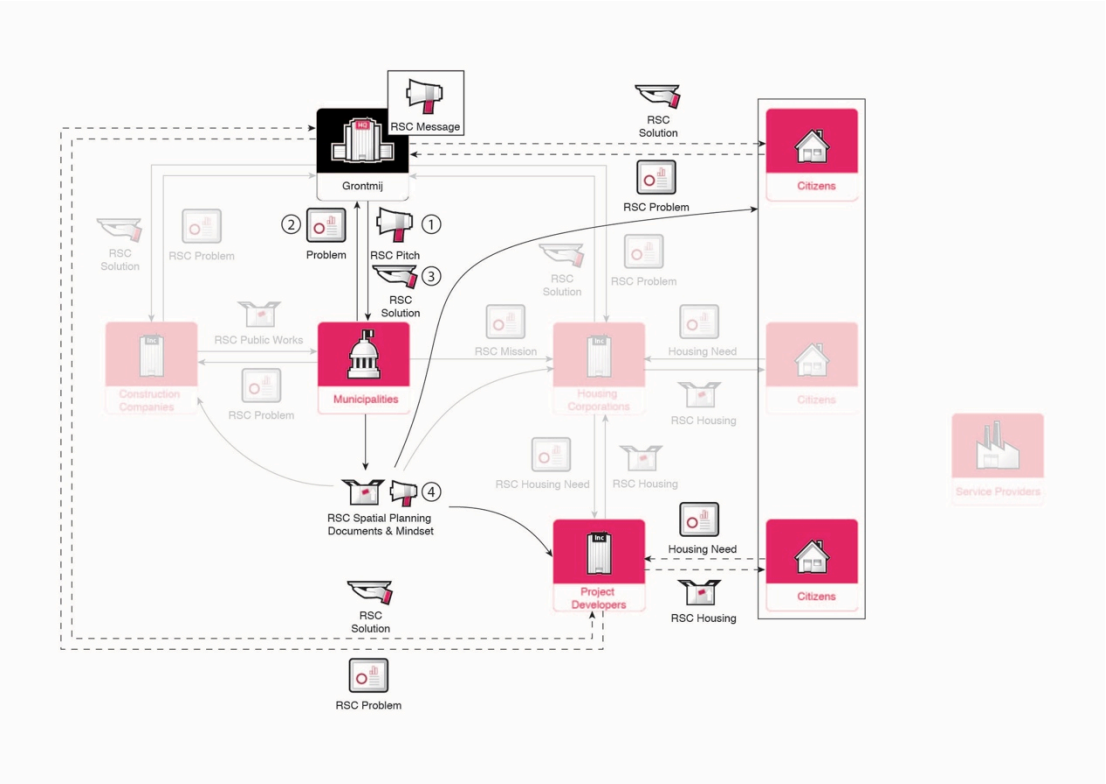


Figure 43 Initial interest Citizens RSC Private Housing

Pro-actively approaching RSC Citizens

Next to the Municipality, the private Citizen can be seen as the most important RSC stakeholder. The Municipality is of prime importance at the Macro scale of RSC implementations, and has strong influence on other stakeholders and as such can also be engaged in the Meso and Micro level. The previous paragraph discussed how actively involving Municipalities might actually spark an initial interest among Citizens in RSC solutions, through Planning Documents, and a sort of peer pressure.

However, to be a true Resilient Smart City Citizens need to want to be involved. A prime aspect of RSC is the decentralization of City Systems to the lowest possible aspect, and this can only partly be achieved through rules and regulations. In fact, the Empowering aspect of the RSC definition implies that Citizens should act on their own wants and needs based upon possibilities offered to them.

By its very definition RSC solutions benefit Citizens. There is a multitude of possible implementations, but all are at least partially focused on improving self-reliance on aspects like energy, water, waste, etc. Again, the exact product or service is not of prime importance, these will change over time, as long as the implementations focus on Resiliency, Empowerment, Sustainability and Efficiency. Engineering Companies like Grontmij have more then enough expertise to develop suitable solutions. Very importantly, a successful implementation will also focus on more basic citizen needs that will inspire initiative, such as financial benefits and a pleasant environment.

As a specific by-note, many RSC implementations require, or would benefit from, cooperation at the level of neighborhoods. Engineering Firms could consider being involved in the organization of such community initiatives

To get Citizens involved in RSC implementations, first they need to be informed on exactly these benefits. This implies a second pro-active approach from the Engineering Firm. The market needs to be convinced of products, services and implementations, why they should be implemented and the specific benefits for end-users, before they will consider implementation. For this a strategy needs to be developed in conjunction with the initial positioning of the Engineering Firm as the specialist in RSC solutions, and the pro-active approach of Municipalities.

The actual implementation of a strategy as described above requires considerable thought, but when successfully implemented it will open up a large new RSC Business Opportunity through Citizens, and eventually Project Developers once they perceive a new market need.

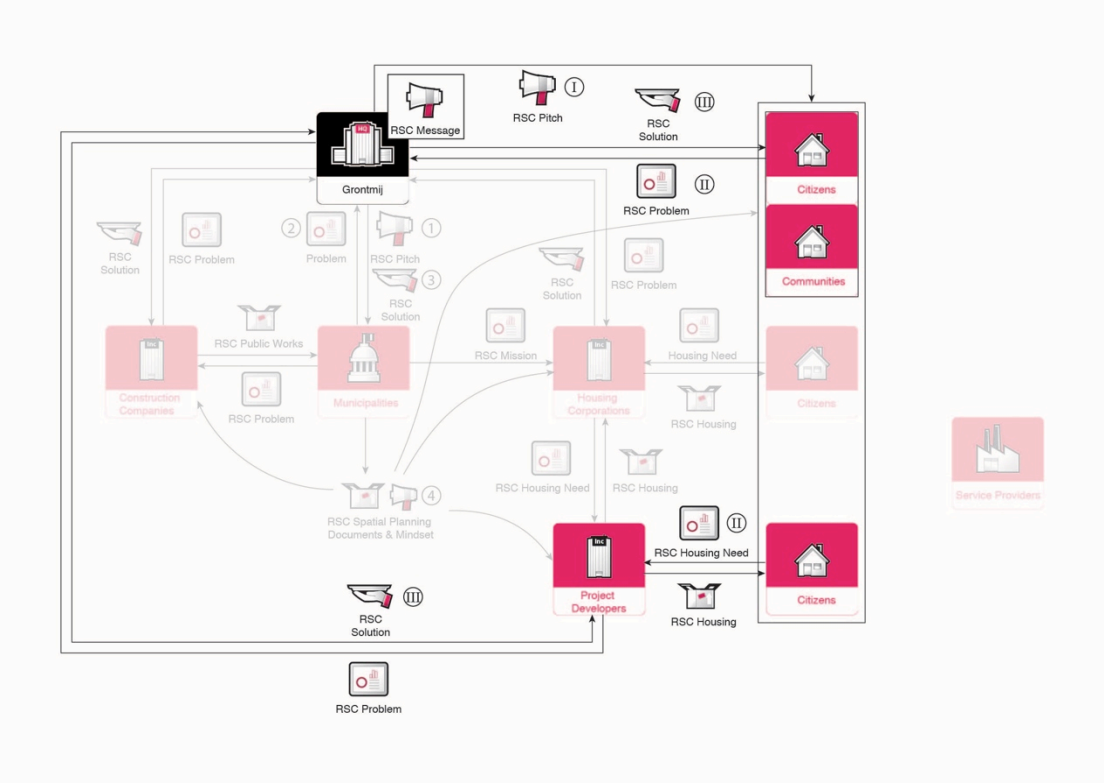


Figure 44 Pro-actively approaching RSC Citizens

RSC Service Providers

Service Providers have a special place in RSC implementations. For them, RSC solutions are at least for a part a threat. Successful RSC implementations will make citizens and communities less reliant on external parties for their needs on different utility services.

At the same time, both in the transition period and in further exploitation it is an illusion that their services will become completely irrelevant. Most likely, smart Service Providers will adapt towards RSC services to maintain a strong market position.

This again implies a Business Opportunity for Engineering Firms to sell services, assuming Service Providers will lack in-house knowledge on RSC processes, at least in the early stages.

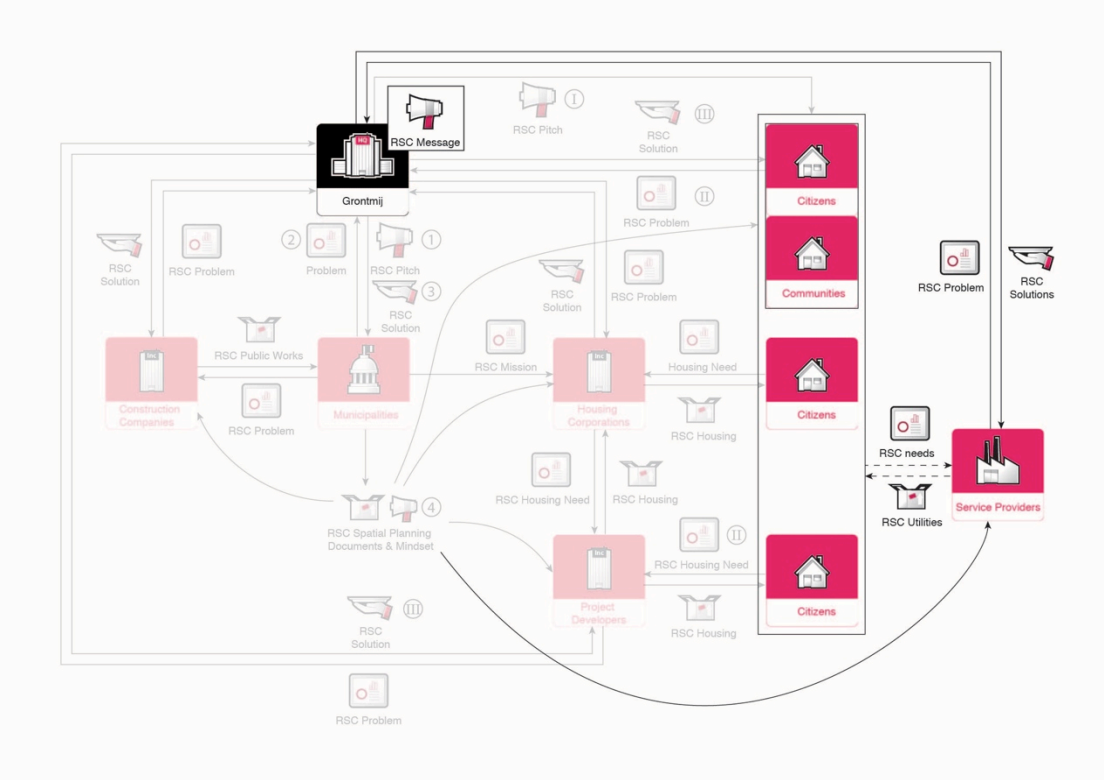


Figure 45 RSC Service Providers

Appendix 3: Potential Strategies for independent RSC Process Management

In this appendix a number of potential strategies for RSC Process Management that are independent from the integrated RSC service suggested in paragraph 3.4. They could provide interesting BOs, but would cloud the streamlined vision presented in the paper and are therefore discussed separately here.

A Business Opportunity that is very closely related to existing Grontmij services is that of RSC Process management. Many potential RSC projects require a re-thinking of present Urban Development and present Planning Laws and Limitations. Ideally, within the context of the Physical Development Plan described in the previous paragraph the city would develop itself, according to the unwritten laws of developing economic, urban development, environment, technological developments, etc. Bottom-up projects initiated by residents and entrepreneurs are most efficient in understanding the possibilities and limitations of urban areas within this context.

As expert in the field of Urban Development in general and RSC specifically an Engineering Firm can offer Process Management support for a wide range of related complicated issues for pro-active customers who are interested in realizing RSC solutions. A non-exhaustive list of examples:

> ***Planning Law Issues***: how to deal with rigid, often obstructive, zoning laws within an resilient, adaptive context
>
> ***Decentralization Issues***: how to deal with the ramifications of localized energy, water and waste systems. What are legal requirements? What is the relationship towards service providers? Which connections are required?
>
> ***Collective Private Housing Developments***: how to organize Collective Private RSC Developments. These are developments at an ideal scale for many decentralized RSC implementations
>
> ***Risk and Failure Cost Management***: many bottom-up RSC projects will be innovative and take place in complex environments. Furthermore, they will often require relatively high initial investments in exchange for an overall lower cost of ownership. What are the risks involved and how can these risks and Failure Costs be minimized? An expert in RSC as well as traditional Urban Development practice can help navigate these issues.
>
> ***Facilitating RSC Partnerships***: In present, and most likely future, urban development the simple construction relationship between client, advisor and contractor is becoming ever less clear. In innovative, complex projects the lines between initiators, advisors and financiers is often dissolved. Complex projects lead to complex partnerships. An expert Engineering Firm can help facilitate or even initiate such partnerships.

Appendix 4: Case-study projects for Verification and Validation

The projects discussed in the following appendices act as partial verification and validation for the theories, strategies and recommendations in the main body of this paper. They do so by proving or disproving the willingness within the company and effectiveness and feasibility within the market of certain ways of working and/or thinking that are closely related to the strategic recommendations.

Appendix 4.1: Decentralization and Citizen Empowerment in a Framework - Almere Oosterwold

A highly interesting project that Grontmij was involved in is the development of Almere Oosterwolde. Although not consciously geared towards RSC aspects it is connected to its train of thought in many ways.

In Oosterwold de municipality of Almere, architectural firm MVRDV and Grontmij collaborated on a spatial development plan for a urban landscape that completely revolves around bottom-up private building projects with as little as possible Public Control. Not only the development of individual houses is left to the private citizen or entrepreneur, but also the building plots, the infrastructure, maintenance, utilities etc. The idea is that the individual, or collective, develops his or her own part of connected networks of infrastructure and green, and each individual handles their own (waste)water system. Here Government is no longer interested in large scale pre-investments and acts facilitating. Prime part of this strategy was to develop a minimal required set of rules, a framework, to provide maximum freedom. Grontmij made the judicial-planological basis in the 'Omgevingsplan' (Environment-plan). (Drevel et al. 2012)

Figure 46 Almere Oosterwolde vision and Generic Plot

This way of thinking is closely related to RSC aspects. A minimal framework was developed, although not on a RSC basis, and within this framework maximum freedom was provided to citizens and entrepreneurs to develop the area naturally, according to their needs. This creates space, or actually demands, decentralized systems and in the process empowers citizens in their own utility needs. All in all it facilitates a resilient, natural development, based upon site qualities and inhabitant needs. Added to this it allows a company like Grontmij to act in cutting edge planning developments.

These sorts of projects are large-scale top-down initiatives that can be very attractive, but require both talented personnel and a unique selling proposition, like RSC thinking, to be able to acquire commissions.

Appendix 4.2: Navigating complex RSC Processes - Investing in Future Revenue

Like described in the main body of this research there seems to be a Business Opportunity in offering RSC project and process management to active potential clients, who want to develop their environments in new and progressive RSC way but lack the knowledge, influence, connections, etc. to navigate the processes involved. How to deal with Planning Law, decentralization issues, Collective Private Developments, etc.?

Grontmij has more than enough in-house expertise in technical, judicial, and project and process management areas but as of yet is not offering them actively outside of their own projects. This is to say, they manage there own projects and processes and they can offer direction level project supervision for large top-down projects. However, they are not clearly involved in offering bottom-up services for individual citizens or entrepreneurs or collectives.

There can be several explanations for this lack in offering a service. Firstly, it can be true that there is no customer base that is interested in these services. However, previous research for this paper suggests that this is likely not the case, especially when potential customers are approached correctly with the right service. In fact, a former employee of Grontmij offers exactly the kind of bottom-up, citizen aimed, process management services in urban development that where suggested as an entrepreneur. (Nicolaas Participaties 2015).

A main difficulty in being able to offer these kinds of services is that they require a pro-active attitude and can take a long time to return on investment. Often many hours need to be spent on difficult processes with many different stakeholders, and no one will pay for these hours directly. This suggests that any company wanting to offer these services has to understand this situation and be willing to deal with it. It cannot for instance require minimum percentages of billable hours and quick return on investment. At present, Grontmij's organization does not easily meet these requirements.

Appendix 4.3: Entrepreneurial Projects - Ruimte voor Ruimte

A significant project that Grontmij Gebiedsadvies is involved in is Ruimte voor Ruimte. Although this is by no means a RSC project, it is quite interesting because it entails a lot of the key characteristics that are suggested to be important in grasping RSC Business Opportunities.

Ruimte voor Ruimte (Space for space) is a Public Private Partnership (PPP) between the province of Noord-Babant, NICB, BNG and Grontmij. It develops building private building plots in exchange for the demolition of livestock stables with the goal to reduce phosphate emissions and the cluttering of the landscape while at the same time providing spacious building plots. Grontmij acted as advisor in the total process of the PPS, financially, judicially and organizationally. They were involved in establishing the venture, project management, process management, engineering advice, etc. (Grontmij 2015b)

As such, this was and is a successful project where the company was involved in in an entrepreneurial fashion. It got actively involved in a PPP construction in Project Development, not necessarily its core business, on a risk baring basis and this allows the implementation of many of the different areas of expertise present in the company and related billable hours and profits. This shows the potential of grasping opportunities in the marketplace by firstly attaching to existing opportunities and secondly being prepared to get involved in a risk baring fashion.

For various reasons Grontmij officially was bought out of the PPP recently. Overall the company seems to be less inclined to be a risk baring partner in projects, which could limit RSC opportunities.

Appendix 4.4: Grasping Opportunities - Smart City Maastricht

In the case of Smart City Maastricht Grontmij was notified that the Municipality of Maastricht was planning to build an underground bicycle parking at the central train station and redevelop the overlying square. This project was purely based upon mobility issues. A project group from Grontmij, including the author, decided to design and hold a pitch at the municipality with the goal of augmenting the municipality's plans towards a (Resilient) Smart City project.

By attaching goals the team knew the municipality had in their planning documents, such as Sustainability and City Branding goals to the redevelopment project, and offering a number of actual number Smart and Resilient solutions that could be integrated, the team was able to spark a strong municipality interest in the importance and possibilities of the Resilient Smart City concept.

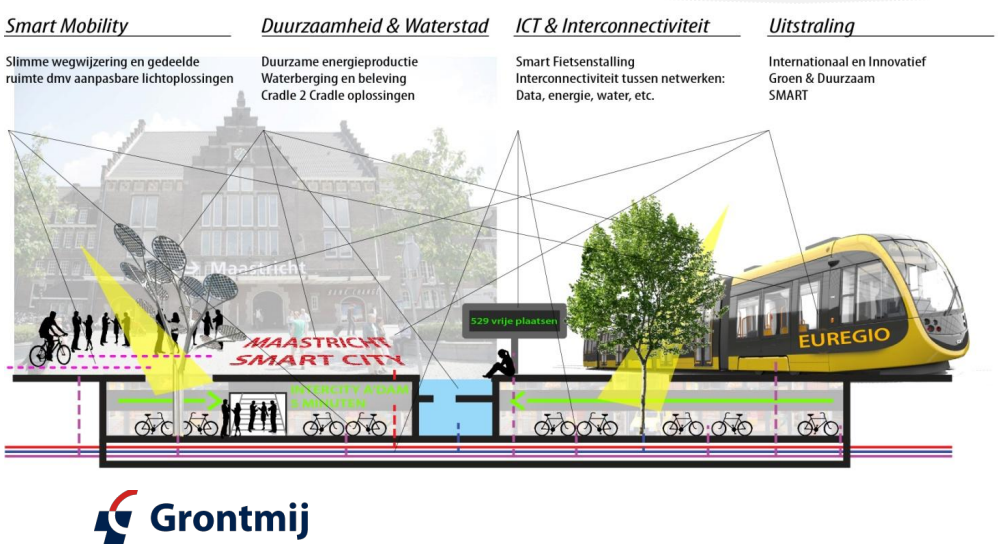
As a direct result of this initiative Grontmij and the municipality of Maastricht are now working together on making the project a Stepping-Stone project towards Maastricht Smart City.

As such this project acted as a starting inspiration for the researches model and as proof of a number of its concepts. Firstly, it indicates a potential interest among municipalities in Resilient Smart City implementations, but a lack of knowledge on the subject, and the fact that their interest can be sparked, even that they can be convinced in getting in involved in services, by pro-actively approaching them with an inspiring RSC vision. It also shows that such a project will only come into being by an entrepreneurial mindset and actions, not only including approaching the customer, but also attaching RSC implementations to existing problems of customers and as such providing optimal value for them. To be able to create and hold the RSC pitch a dedicated team with available time was needed. Without this the project would not be possible. Also, In contacting the municipality contacts with other stakeholders were quickly made, verifying the importance of this stakeholder. Lastly, the project verifies the idea that relatively small scale and practical projects can act as a bottom-up stepping stone towards the Resilient Smart City.

Smart City Maastricht

Een slim en adaptief Stationsplein als Stepping-Stone

Het plan heeft 4 kernpunten…	…met concrete toepassingen als	…die gedeeltelijke gedekt kunnen worden door subsidies
1) Smart Mobility 2) Duurzaamheid & Waterstad 3) ICT & Inter-connectie 4) Uitstraling	- Zonnepanelen, waarop gelopen kan worden, in de letters 'Maastricht' op het plein - Een Smart fietsenstallingbord dat aangeeft waar en hoeveel plekken er vrij zijn - Waterberging bij hevige wateroverlast, altijd waterbeleving - Slimme bewegwijzering en plaatsaanwijzing d.m.v. lichtoplossingen	**Horizon 2020 Smart Cities (EU)** Integratie van laag energieverbruik, ICT infrastructuur & duurzame mobiliteit op lokaal schaalniveau. Per project maximaal €250.000,-



Grontmij


Maastricht als internationaal knooppunt


Verbeter efficiëntie en gebruiksgemak


Aantrekkelijke stadsentree als ontmoetingsplaats


Aantrekkingskracht voor ondernemers in de regio


Draag bij aan een duurzame wereld

Figure 47 Smart City Maastricht One-pager