Assessment and Normative Guidance of the Collective Mindset Maturity Regarding Open Data in Smart Cities

- A Grounded Theory Approach to the Understanding of Open Data as an Enabler of Strategic Cross-Sector Open Innovation and Long-Term Smart City Sustainability.

> Mikkel Thordal Andersen mtan12@student.aau.dk Santosh Bhandari sbhand13@student.aau.dk

> > Aalborg University Copenhagen Master Thesis Supervisor: Iwona Windekilde

> > > January 5th, 2015



Abstract

This master thesis is concerned with the emerging concept of open data and how it functions as an enabler of sustainable smart city solutions. We borrow the concept of maturity from the field of Enterprise Architecture (EA) to describe the level of willingness among smart city actors to open up data and the level of their open data understanding. We want to find out how to create a conceptual model for assessing open data mindset maturity of a smart city ecosystem, which normatively can function as a guideline for relevant actors. A grounded theory methodology is used to incrementally construct knowledge and end up with verified theory.

Empirical data is gathered from interviews with experts in the fields of smart cities, open data, and sustainability and it is analysed by means of systems theory, ecosystems theory, institutional design theory, and open innovation theory.

The findings from the analysis are assembled into a normative model, which we call the Open Governance Maturity Matrix. The maturity matrix aligns the open data willingness and mindsets of relevant actors in a specific open data project and provides guidelines to further action towards successful long-term project realization. It combines (1) three important subjects of open data in a smart city context with (2) specific questions for relevant actors and (3) the identification of maturity stages into three dimensions. We show that it is possible to systematically create a model that prescribes or relates to the norm for how to behave in an open data smart city context, and we outline it in an initial, conceptual form. This is an important finding that contributes to contemporary smart city and open data research.

The research yields grounded theory concerning the categorization of open data maturity and suggests a taxonomy outlining five different aspects of maturity in an open data, smart city context. This is a useful tool for understanding and discussing open data among actors. The research concludes that (*Theorem 1*) sustainability and sustainable development must be fostered from a bottom-up approach in a complex system such as a smart city. Finally we contribute to the smart city discourse by defining a smart city as (*Theorem 2*) a complex purposive system consisting of ideal-seeking subsystems that are in a continuous process of evolving and integrating with other subsystems and in which actors are in a continuous process of breaking down business silos.

Contents

1 Introduction		1		
	1.1	Backg	round of the Research	1
		1.1.1	Smart cities, innovation, and new urban digital agendas \ldots	2
		1.1.2	Relevance of open data	5
		1.1.3	Smart city maturity concerning open data	7
	1.2	Resear	rch Question	9
	1.3	Resear	rch Objectives	9
	1.4	Resear	rch Significance	9
	1.5	Readi	ng Guide	11
2	Lite	erature	Review	13
	2.1	Smart	Cities	14
		2.1.1	What is a smart city?	14
		2.1.2	Components and characteristics of smart cities	15
		2.1.3	The smart city as a complex ecosystem	20
	2.2	Sustai	nability	22
		2.2.1	Different types of Sustainability	22
		2.2.2	Smart cities, sustainability and sustainable development $\ . \ .$	22
		2.2.3	Open innovation for sustainable smart cities	24
		2.2.4	Factors driving the growth of sustainable smart cities	25
	2.3	Data		25
		2.3.1	Big data, Open Data and Open Government	26
		2.3.2	Relation between Big Data, Open Data, and Open Government	28
		2.3.3	Open data as an innovation enabler	29
		2.3.4	Open data for sustainable development in smart cities \ldots .	30
		2.3.5	Reluctance in opening data	30
		2.3.6	Open Data Technologies	31
	2.4	Matur	ity	33
		2.4.1	EA maturity model – Ross et. al (2006) $\ldots \ldots \ldots \ldots$	33
		2.4.2	EA maturity matrix – Berg and Steenbergen (2007)	34
		2.4.3	Smart Cities Wheel – Boyd-Cohen	35
		2.4.4	Smart City Maturity Model – IDC Government Insights (Cla-	
			rke, 2013a)	37
		2.4.5	Open Government Maturity Model – Gartner (2010)	38
		2.4.6	Open Government Data Maturity Model – Tauberer (2014) .	38

Ι

3.1 Systems Theory 40 3.1.1 What characterizes a system? 41 3.1.2 Applying systems theory 42 3.2 Ecosystems Theory 44 3.2.1 Business Ecosystems 44 3.2.2 The New ICT Ecosystem 44 3.2.2 The New ICT Ecosystem 48 3.3 Institutional design for complex ecosystems 49 3.3.1 Institutional Theory 49 3.3.2 Metamodel for Institutional Design 51 3.4 Open Innovation 52 3.4.1 From Closed to Open Innovation 52 3.4.2 Steps in developing open innovation 54 3.4.3 Open innovation in the public and private sector 54 4 Methodology 56 4.1 Scientific Considerations 56 4.1.1 Research Philosophy 56 4.1.2 Epistemological Choice 58 4.1.3 Methodological Decisions 58 4.1.4 Qualitative Research Interview as Empirical Data Gathering 60 4.2 Pre
3.1.1 What characterizes a system? 41 3.1.2 Applying systems theory 42 3.2 Ecosystems Theory 44 3.2.1 Business Ecosystems 44 3.2.2 The New ICT Ecosystem 44 3.2.2 The New ICT Ecosystem 48 3.3 Institutional design for complex ecosystems 49 3.3.1 Institutional Theory 49 3.3.2 Metamodel for Institutional Design 51 3.4 Open Innovation 52 3.4.1 From Closed to Open Innovation 52 3.4.2 Steps in developing open innovation 54 3.4.3 Open innovation in the public and private sector 54 4.1 Scientific Considerations 56 4.1.1 Research Philosophy 56 4.1.2 Epistemological Choice 58 4.1.3 Methodological Decisions 58 4.1.4 Qualitative Research Interview as Empirical Data Gathering 60 4.2 Presentation of Interviewees 61 4.2.1 Kristoffer Hvidsteen 61
3.1.2 Applying systems theory 42 3.2 Ecosystems Theory 44 3.2.1 Business Ecosystems 44 3.2.2 The New ICT Ecosystem 48 3.3 Institutional design for complex ecosystems 49 3.3.1 Institutional Theory 49 3.3.2 Metamodel for Institutional Design 51 3.4 Open Innovation 52 3.4.1 From Closed to Open Innovation 52 3.4.2 Steps in developing open innovation 52 3.4.3 Open innovation in the public and private sector 54 4 Methodology 56 4.1 Scientific Considerations 56 4.1.1 Research Philosophy 56 4.1.2 Epistemological Choice 58 4.1.3 Methodological Decisions 58 4.1.4 Qualitative Research Interview as Empirical Data Gathering 60 4.2 Søren Møller Jensen 61 4.2.3 Henrik Korsgaard 62
3.2 Ecosystems Theory 44 3.2.1 Business Ecosystems 44 3.2.2 The New ICT Ecosystem 48 3.3 Institutional design for complex ecosystems 49 3.3.1 Institutional Theory 49 3.3.2 Metamodel for Institutional Design 51 3.4 Open Innovation 52 3.4.1 From Closed to Open Innovation 52 3.4.2 Steps in developing open innovation 52 3.4.3 Open innovation in the public and private sector 54 3.4.3 Open innovation in the public and private sector 56 4.1 Scientific Considerations 56 4.1.1 Research Philosophy 56 4.1.2 Epistemological Choice 58 4.1.3 Methodological Decisions 58 4.1.4 Qualitative Research Interview as Empirical Data Gathering 60 4.2 Presentation of Interviewees 61 4.2.1 Kristoffer Hvidsteen 61 4.2.2 Søren Møller Jensen 61 4.2.3 Henrik Korsgaard 62 <
3.2.1 Business Ecosystems 44 3.2.2 The New ICT Ecosystem 48 3.3 Institutional design for complex ecosystems 49 3.3.1 Institutional Theory 49 3.3.2 Metamodel for Institutional Design 51 3.4 Open Innovation 52 3.4.1 From Closed to Open Innovation 52 3.4.2 Steps in developing open innovation 54 3.4.3 Open innovation in the public and private sector 54 4 Methodology 56 4.1 Scientific Considerations 56 4.1.1 Research Philosophy 56 4.1.2 Epistemological Choice 58 4.1.3 Methodological Decisions 58 4.1.4 Qualitative Research Interview as Empirical Data Gathering 60 4.2 Presentation of Interviewees 61 4.2.1 Kristoffer Hvidsteen 61 4.2.2 Søren Møller Jensen 61 4.2.3 Henrik Korsgaard 62
3.2.2 The New ICT Ecosystem 48 3.3 Institutional design for complex ecosystems 49 3.3.1 Institutional Theory 49 3.3.2 Metamodel for Institutional Design 51 3.4 Open Innovation 52 3.4.1 From Closed to Open Innovation 52 3.4.2 Steps in developing open innovation 52 3.4.3 Open innovation in the public and private sector 54 3.4.3 Open innovation in the public and private sector 54 4.1 Scientific Considerations 56 4.1.1 Research Philosophy 56 4.1.2 Epistemological Choice 58 4.1.3 Methodological Decisions 58 4.1.4 Qualitative Research Interview as Empirical Data Gathering 60 4.2 Presentation of Interviewees 61 4.2.1 Kristoffer Hvidsteen 61 4.2.2 Søren Møller Jensen 61 4.2.3 Henrik Korsgaard 62
3.3 Institutional design for complex ecosystems 49 3.3.1 Institutional Theory 49 3.3.2 Metamodel for Institutional Design 51 3.4 Open Innovation 52 3.4.1 From Closed to Open Innovation 52 3.4.2 Steps in developing open innovation 52 3.4.3 Open innovation in the public and private sector 54 3.4.3 Open innovation in the public and private sector 54 4 Methodology 56 4.1 Scientific Considerations 56 4.1.2 Epistemological Choice 58 4.1.3 Methodological Decisions 58 4.1.4 Qualitative Research Interview as Empirical Data Gathering 60 4.2 Søren Møller Jensen 61 4.2.3 Henrik Korsgaard 61
3.3.1 Institutional Theory 49 3.3.2 Metamodel for Institutional Design 51 3.4 Open Innovation 52 3.4.1 From Closed to Open Innovation 52 3.4.2 Steps in developing open innovation 54 3.4.3 Open innovation in the public and private sector 54 4 Methodology 56 4.1 Scientific Considerations 56 4.1.1 Research Philosophy 56 4.1.2 Epistemological Choice 58 4.1.3 Methodological Decisions 58 4.1.4 Qualitative Research Interview as Empirical Data Gathering 60 4.2 Presentation of Interviewees 61 4.2.1 Kristoffer Hvidsteen 61 4.2.3 Henrik Korsgaard 61
3.3.2 Metamodel for Institutional Design 51 3.4 Open Innovation 52 3.4.1 From Closed to Open Innovation 52 3.4.2 Steps in developing open innovation 54 3.4.3 Open innovation in the public and private sector 54 4 Methodology 56 4.1 Scientific Considerations 56 4.1.1 Research Philosophy 56 4.1.2 Epistemological Choice 58 4.1.3 Methodological Decisions 58 4.1.4 Qualitative Research Interview as Empirical Data Gathering 60 4.2 Presentation of Interviewees 61 4.2.1 Kristoffer Hvidsteen 61 4.2.3 Henrik Korsgaard 61
3.4 Open Innovation 52 3.4.1 From Closed to Open Innovation 52 3.4.2 Steps in developing open innovation 54 3.4.3 Open innovation in the public and private sector 54 4 Methodology 56 4.1 Scientific Considerations 56 4.1.1 Research Philosophy 56 4.1.2 Epistemological Choice 58 4.1.3 Methodological Decisions 58 4.1.4 Qualitative Research Interview as Empirical Data Gathering 60 4.2 Presentation of Interviewees 61 4.2.1 Kristoffer Hvidsteen 61 4.2.3 Henrik Korsgaard 62
3.4.1 From Closed to Open Innovation 52 3.4.2 Steps in developing open innovation 54 3.4.3 Open innovation in the public and private sector 54 4 Methodology 56 4.1 Scientific Considerations 56 4.1.1 Research Philosophy 56 4.1.2 Epistemological Choice 58 4.1.3 Methodological Decisions 58 4.1.4 Qualitative Research Interview as Empirical Data Gathering 60 4.2 Presentation of Interviewees 61 4.2.1 Kristoffer Hvidsteen 61 4.2.3 Henrik Korsgaard 62
3.4.2 Steps in developing open innovation 54 3.4.3 Open innovation in the public and private sector 54 4 Methodology 56 4.1 Scientific Considerations 56 4.1.1 Research Philosophy 56 4.1.2 Epistemological Choice 56 4.1.3 Methodology 56 4.1.4 Qualitative Research Interview as Empirical Data Gathering 60 4.2 Presentation of Interviewees 61 4.2.1 Kristoffer Hvidsteen 61 4.2.3 Henrik Korsgaard 62
3.4.3 Open innovation in the public and private sector 54 4 Methodology 56 4.1 Scientific Considerations 56 4.1.1 Research Philosophy 56 4.1.2 Epistemological Choice 58 4.1.3 Methodological Decisions 58 4.1.4 Qualitative Research Interview as Empirical Data Gathering 60 4.2 Presentation of Interviewees 61 4.2.2 Søren Møller Jensen 61 4.2.3 Henrik Korsgaard 62
4 Methodology 56 4.1 Scientific Considerations 56 4.1.1 Research Philosophy 56 4.1.2 Epistemological Choice 58 4.1.3 Methodological Decisions 58 4.1.4 Qualitative Research Interview as Empirical Data Gathering 60 4.2 Presentation of Interviewees 61 4.2.1 Kristoffer Hvidsteen 61 4.2.3 Henrik Korsgaard 62
4.1 Scientific Considerations 56 4.1.1 Research Philosophy 56 4.1.2 Epistemological Choice 56 4.1.3 Methodological Decisions 58 4.1.4 Qualitative Research Interview as Empirical Data Gathering 60 4.2 Presentation of Interviewees 61 4.2.1 Kristoffer Hvidsteen 61 4.2.3 Henrik Korsgaard 62
4.1.1Research Philosophy564.1.2Epistemological Choice584.1.3Methodological Decisions584.1.4Qualitative Research Interview as Empirical Data Gathering604.2Presentation of Interviewees614.2.1Kristoffer Hvidsteen614.2.2Søren Møller Jensen614.2.3Henrik Korsgaard62
4.1.2 Epistemological Choice 58 4.1.3 Methodological Decisions 58 4.1.4 Qualitative Research Interview as Empirical Data Gathering 60 4.2 Presentation of Interviewees 61 4.2.1 Kristoffer Hvidsteen 61 4.2.2 Søren Møller Jensen 61 4.2.3 Henrik Korsgaard 62
4.1.3 Methodological Decisions 58 4.1.4 Qualitative Research Interview as Empirical Data Gathering 60 4.2 Presentation of Interviewees 61 4.2.1 Kristoffer Hvidsteen 61 4.2.2 Søren Møller Jensen 61 4.2.3 Henrik Korsgaard 62
4.1.4Qualitative Research Interview as Empirical Data Gathering .604.2Presentation of Interviewees
4.2Presentation of Interviewees614.2.1Kristoffer Hvidsteen614.2.2Søren Møller Jensen614.2.3Henrik Korsgaard62
4.2.1 Kristoffer Hvidsteen 61 4.2.2 Søren Møller Jensen 61 4.2.3 Henrik Korsgaard 62
4.2.2Søren Møller Jensen614.2.3Henrik Korsgaard62
4.2.3 Henrik Korsgaard
$4.2.4 \text{Søren Kvist} \dots \dots \dots \dots \dots \dots \dots \dots \dots $
4.2.5 Ville Meloni
$4.2.6 \text{Adrian Ulisse} \dots \dots \dots \dots \dots \dots \dots \dots \dots $
4.2.7 Lasse Steenbock Vestergaard
5 Analysis 66
5.1 Preliminary grounded findings
5.2 Validity of the Interviews
5.3 Findings
5.3.1 Business silos breakdown – the necessity for a holistic approach 71
5.3.2 Top-down versus bottom-up approaches
5.3.3 Maturity – a collective open data mindset $\ldots \ldots \ldots \ldots 83$
5.3.4 Summarizing the findings
5.4 The Model/Framework
5.4.1 Fundamentals of the Model/Framework
5.4.2 Normative model/framework for open data mindset maturity 90
5.4.3 Explaination of the Open Governance Maturity Matrix (Table 5.2)
5.4.4 The three subjects of consideration for maturing the open data
mindset collaboratively.
5.4.5 Explanation of actors dependency (D1)
5.4.6 Detailed explanation of maturity stages
5.4.7 Possible working Model/Framework

II

6	Dise	Discussion 1		
	6.1 Theoretical Justification of the Open Governance Maturity 1		105	
	6.2	Practical Concerns Regarding the Open Governance Maturity Matrix	108	
		6.2.1 Maturity concerns while integrating to other open data projects	s 108	
		6.2.2 Uncertainties regarding time and funding	108	
		6.2.3 Privacy concerns and legal barriers	109	
		6.2.4 Concerns regarding proper institutional design	110	
		6.2.5 Involvement of the whole quadruple helix - what about the		
		citizens and academia?	110	
	6.3	The Final Thoughts – what we have learned	111	
		6.3.1 Grounded theory	111	
		6.3.2 Answers to our research question	112	
		6.3.3 Ideas for future research	113	
7	Con	clusion	115	
8	Bib	liography	118	
\mathbf{A}	Tra	nscriptions of Interviews	124	
	A.1	Kristoffer Hvidsteen	124	
	A.2	Adrian Ulisse	135	
	A.3	Søren Møller Jensen	143	
	A.4	Henrik Korsgaard	153	
	A.5	Søren Kvist	161	
	A.6	Lasse Steenbock Vestergaard	174	
	A.7	Ville Meloni	184	
в	Inte	erview Guides	196	
	B.1	Interview Guide for Kristoffer Hvidsteen	196	
	B.2	Interview Guide for Søren Møller Jensen	197	
	B.3	Interview Guide for Henrik Korsgaard	198	
	B.4	Interview Guide for Søren Kvist	199	
	B.5	Interview Guide for Ville Meloni	200	
	B.6	Interview Guide for Adrian Ulisse	201	
	B.7	Interview Guide for Lasse Steenbock Vestergaard	202	

203

List of Figures

1.1	Top-down and bottom-up approaches to encouraging the participation of citizens and stakeholders in Smart Cities (Manville et al., 2014, p.	
	78).	4
1.2	Triple-helix & Quadruple-helix (http://www.12manage.com)	4
1.3	Architecture Maturity Stages (Ross et al., 2006)	8
2.1	Fundamental components of smart city (Nam and Pardo, 2011, p. 286)	15
2.2 2.3	Characteristics and factors of a smart city (Giffinger et al., 2007, p. 12) Relationship between components and characteristics of Smart Cities	16
2.0	$(Manville et al., 2014, p. 30) \dots \dots$	18
2.4	Smart City initiatives framework. (Chourabi et al., 2012, 2294)	19
2.5	Smart City Key Success Factors (Clarke, 2013a, p. 8)	21
2.6	Relation between Open Data, Big Data and Open Government (Gurin,	
	2014, p. 253)	28
2.7	The Web Services Model (https://support.novell.com/techcente	
	r/articles/dnd20030304.html)	32
2.8	Components of the web services architecture (Hofmann and Beaumont,	
	2005, p. 247)	32
2.9	Architecture Maturity Matrix (Berg and Steenbergen, 2007, p. 152).	34
2.10	Smart Cities Wheel (http://www.boydcohen.com/smartcities.html)	36
2.11	Smart City Maturity Model (Clarke, 2013a, p. 7)	37
2.12	Gartner Open Government Maturity Model (http://tinyurl.com/2b	
	zq99y)	38
2.13	A Maturity Model for Prioritizing Open Government Data (Tauberer	
	$(2014)) \ldots $	39
3.1	System Image Forming (Haaf et al., 2002, p. 54)	41
3.2	Symbolisation of the concept 'system' (Haaf et al., 2002, p. 55)	42
3.3	Symbolisation of a subsystem (Haaf et al., 2002, p. 56)	42
3.4	An example of an interdisciplinary approach to a multi-aspect problem	
	(Haaf et al., 2002, p. 63)	43
3.5	The four-layer model: levels of institutional analysis (Koppenjan and	
	Groenewegen, 2005, p. 247)	50
3.6	The metamodel: a generic model of the design process (Koppenjan	
	and Groenewegen, 2005, p. 252)	51
3.7	The Closed Innovation Model (Chesbrough, 2003, p. 36)	52
3.8	The Open Innovation Model (Chesbrough, 2003, p. 37)	53

5.1	Summary of our findings	88
5.2	Open Governance Maturity Matrix (possible working model/framework)	103

List of Tables

3.1	The Evolutionary Stages of a Business Ecosystem (Moore, 1993, p. 77)	45
5.1	Maturity categories in an open data, smart city context	84
5.2	Open Governance Maturity Matrix	92
5.3	Open Governance Maturity Conditions	95
5.4	Project Questions For Relevant Actors	98
5.5	Open Data Working Questionnaire for Actors (D1)	100
5.6	Open Governance Maturity Matrix (conditions replaced by characters)	101

Chapter 1 Introduction

The Information and Communications Technology (ICT) convergence has enabled new business opportunities as a result of increasing vertical and horizontal integration possibilities. The Internet is increasingly used as a multi-sided platform that can connect businesses and people and inherently bring down transaction costs and thereby attract even more people. It forms the basis of the concept of smart cities where ICT technologies are used in common city-wide solutions to issues emerging from increasing urbanisation and inefficient utilisation of resources within the city. Sustainability is gradually becoming an underlying goal of smart cities and ICT is seen as a means to exploit the value of existing resources more efficiently by allowing new kinds of open innovation. Additionally, ICT can be used as a means to align the mindsets of city actors and create common sustainable goals by structuring and opening public and private data.

This master thesis investigates the concepts of smart cities, sustainability, and open data with the goal to understand how they relate to each other.

In this chapter we will introduce the problem area and background of the research, based on the current smart city discourse, existing literature, and research that point towards our research questions. We then describe the objectives and expected outcome of our research. It is important for us to outline the importance and significance of our research, and so we have dedicated a section for that. The last section in this chapter is a reading guide explaining the structure of the thesis and what kind of information the reader can expect to find in each chapter.

1.1 Background of the Research

The predominant point of departure of our research is the accelerating, global smart city discourse, which is constantly influencing the awareness of strategic development, implementation, and deployment of ICT with regards to, i.a., natural resource management, transport and mobility services, facility management, E-government, innovation and entrepreneurship, and more generally enabling sustainable development within cities (Neirotti et al., 2014, pp. 27-28).

In the following subsections we will outline relevant parts of the current smart city agenda and show how the concept of open data management can function as a fundamental smart city enabler. We will point to research which discuss the nature of open data and explain how open data can catalyse certain kinds of innovation if handled with circumspection.

Various open data initiatives already exist as parts of several smart city programmes, and for them to be successful and deliver to their full potential, it seems crucial to have established what one can characterize as an ecosystem of the relevant actors, such as policymakers, public institutions, private companies, independent developers, and end users of open data services (Fransman, 2010). It also seems necessary to identify cross-sector factors for sustainable development and find incentives to catalyse involvement. The concept of ecosystems can be used to understand smart cities as organisms capable of manipulation by means of systems thinking and institutional theory for increasing the tangibility of those circumstances necessary for successful open data management.

We will point to literature and cases indicating that for open data initiatives to deliver to their full potential, the smart city has to have a certain level of maturity towards understanding the potential of open data and the prerequisites of unleashing this potential. Maturity is a well known concept from areas such as enterprise architecture where maturity level measurements are used normatively to enable organisations to integrate their technology and data as inherent parts of top level decision making and business process models. Maturity models are used as guidelines to strategic investments and give organisations a means to constantly develop with regards to exploiting value of in-house resources, information, and knowledge (Ross et al., 2006). We draw a parallel between enterprise architecture and smart city maturity and raise the hypothesis that open data management in a smart city context can benefit from increasing the open data maturity by means of a holistic and systemic approach. This can be done by creating a normative, testable open data maturity model for smartcities, which will help them assess their own open data readiness and understand value of a contingency approach. During this section we will hopefully come up with clarifying answers to the most urgent questions regarding our research. And so, this section functions as a small preliminary literature review.

1.1.1 Smart cities, innovation, and new urban digital agendas

The point of departure is the rising phenomenon of smart cities as an overall reference to the rising urbanisation and increasingly populated cities solving current and future challenges and providing services by means of digital initiatives (Manville et al., 2014, p. 17; Clarke, 2013b, p. 1). In the recent publication "Mapping Smart Cities in the EU" the European Union put main emphasis on how the "major urbanisation requires new and innovative ways to manage the complexity of urban living" (Manville et al., 2014, p. 17). And so, the smart city terminology does not primarily refer to an overall goal of improving the quality of life – it mainly addresses the fact that collective longterm planning is needed to ensure that today's quality of life can be sustained into the future.6

Even though there are many contributions to the on-going smart city discourse, it seems of broad acceptance that a prerequisite of sustainable improvement of quality of life is to ensure the current living standards on a long-term basis. In smart

 $\mathbf{2}$

cities innovation ability is seen to be a key factor, which explains a strong focus on innovation-enablers.

Innovation can occur in many different areas – from smart technology to smart governance; Chourabi et al. (2012) provide eight different areas, which incorporate several factors for successful smart city initiatives: Management and organization, Technology, Governance, Policy context, People and communities, Economy, Built infrastructure, and Natural environment. These areas are highly interconnected and the authors emphasise how innovation can occur in all of these – from a governance/managerial process level to core technology innovation (Chourabi et al., 2012, pp. 2291-2294). Technology is, however, an enabler of innovation in the other areas, and

"ICTs are key drivers of smart city initiatives. The integration of ICT with development projects can change the urban landscape of a city and offer a number of potential opportunities, they can enhance the management and functioning of a city." (Chourabi et al., 2012, p. 2291)

The ideal smart city can tackle the complexity of smart city management by means of a strong integration of ICT in core areas of its strategy development and decision making processes, which leads to changes in people, community, and natural environment levels. This point is emphasised concurrently in various research (Lee et al., 2013; Clarke, 2013b; Laitner, 2015; Mattern et al., 2010) and it is the underlying driver and argument of the Horizon 2020 work programme for 2014-2015 about *"leadership in enabling and industrial technologies"* (European Commission, 2013).

Smart city governance issues

ICT can function as an enabler of innovation both from a direct top-down perspective and an indirect bottom-up perspective. This innovation-enabling aims at fostering a culture where smart city actors collectively seek to "generate greater and more sustainable economic development and a better quality of life" (Manville et al., 2014, p. 18)¹. It is, however, evidently important to balance the two approaches so that a certain innovation mindset is fostered and directed from a top-down perspective (e.g city-counsel), which encourages people to participate in forming their surroundings (bottom-up approach) in a sustainable manner (smart people) (Manville et al., 2014, p. 77). Figure 1.1 depict the top-down and bottom-up approaches.

The control of smart city agenda-setting is a main obstacle for *maturing* the smart city on the actor-level with *wicked problems* (Rittel and Webber, 1973) causing conflicts of interests and a game of stagnation where solutions are non-linear and notoriously imperfect:

"When development processes are characterized by uncertainty, the companies' handling of this uncertainty becomes crucial to the ability to innovate. [...]. Because uncertainty in the development process also often indicate that it is unclear who are the relevant stakeholders in a project, it can be a challenge to get the process initiated. Also the fear of failing innovation projects can cause inertia in the process." (Jensen, 2014, p. 46)

 $^{^{1}}$ In the literature review (chap. 2) we will elaborate more on the innovation-enabling functions of ICT in a smart city context.



Figure 1.1: Top-down and bottom-up approaches to encouraging the participation of citizens and stakeholders in Smart Cities (Manville et al., 2014, p. 78).



Figure 1.2: Triple-helix & Quadruple-helix (http://www.12manage.com)

Some companies have adopted an open mindset, which is characterized by engagement in development processes where the company cannot define a perfect business model from the beginning and is willing to challenge the settings of its own professional field (Jensen, 2014, p. 46). But for it to become successful on a long term basis, the other actors of the (smart city) system, such as the government/municipality, accordingly have to follow the same pace of mindset development. Importantly, such a collective innovation-approach to smart city solutions inherently requires a high level social capital to permit alignment of the mindset of the actors (Akçomak and ter Weel, 2008, p. 25). Danish smart city researcher Søren Møller Jensen identifies this as a *quadruple helix* (see fig. 1.2), where the traditional triple helix is extended to consider the citizens as actors in smart city development:

"As in any form of user-driven innovation, the citizens are not necessarily capable of defining what they really need - partly because the realization is created over time. Furthermore, companies and other actors play an important role in decoding the citizens' experience of tested solutions, which are necessary for the formulation of visions for further development of the city. Citizen involvement cannot replace the visions of private and public actors but can be seen as an important facilitator." (Jensen, 2014, p. 28)

One way to harvest the value of a social system, such as a smart city, and embrace the idea that social contacts and networks affect the productivity of individuals and groups (Putnam, 2000) is by motivating for *opening up* data across both public and private sectors (Clarke, 2013b, p. 8).

1.1.2 Relevance of open data

The open data movement is a relatively new paradigm within city development and is being treated as one of the core matters of turning the conventional city into a smart city (Gurstein, 2011, p. 1). Open data in the smart city context is not a well-defined set of rules and guidelines to which kind of data to publish etc. There is not a strict consensus regarding the type of data, which should be "opened up" – if it includes public data, private data, or a mix of both. There is not even a strict definition of what "opened up" means in terms of this data².

If one look at the open data contributions by the European Commission as part of the Horizon 2020 strategy, they emphasize that public data should increasingly be seen as a resource, and the European Union has to strengthen its innovative potential to use this resource in the best possible way and by that support a sustainable growth path (European Commission, 2011, p. 2). And so, they see open data initiatives as a way to re-use publicly made data, and by that making it "live longer". Furthermore, they write that "[o]pening up public data will also foster the participation of citizens in political and social life and contribute to policy areas such as the environment" (European Commission, 2011, p. 2), indicating that open public data has a potentially democratizing effect by enabling the involvement of citizens in governance matters.

Jensen (2014) argues that the data can be both private and public. He emphasizes the fact that the increasing amount of and access to real-time, dynamic data also makes open data an important asset for cross-sector innovation (Jensen, 2014, p. 31). He quotes Sustainability Lead at Accenture, Kristoffer Hvidsteen:

"Many people talk about the intelligent city, but nobody has actually arrived there yet. The necessity for an understanding of digital technology in combination with strategic insight has made it difficult to get started. The biggest potentials are to be found in the field between public and private data, which raises some issues regarding incentives and collaboration." (Jensen, 2014, p. 31)

 $^{^{2}}$ In the literature review, chapter 2, we will give an in-depth analysis of the current open data trends and landscape.

The author concludes that both public and private actors are locked-in to *silo-thinking* where they are only capable of focusing on solutions within their own familiar field instead of challenging this field by bringing in other subject areas. It requires some level of collective maturity to get out of this technological and organisational silo-thinking, and open data can itself function as an enabler of this by providing a common language.

It seems like there is crucial balance between opening up government data just for the sake of transparency and fostering open data for the sake of collective innovation. Again it boils down to smart city governance issues – how to motivate institutions to collectively mitigate risks and harvest the potential of open data? Who's task is that?

The United Kingdom has a well-developed open data initiative where transparency is pivotal. In the white paper "Unleashing the Potential" (The UK Cabinet Office, 2012) they outline many possibilities for fostering innovation by carefully selecting and forming public data before opening it, but they do not quite unleash the potential of privately held data and harvest the value of including the entire quadruple helix. This prevents a holistic approach to smart city development, where no sector can be excluded if long-term sustainability is a main goal. One central aspect of open data is its built-in potential to involve all actors in the quadruple helix and foster bottom-up innovation and create an environment for long-term, sustainable smart city development and management.

Open data and sustainability

Until now we have described how cities have a possibility to use ICT to enable development of solutions to urgent issues in other sectors caused by increasing urbanization. We have shown how open data can bring together smart city actors and catalyse a collective approach to smart city development with the right balance between top-down and bottom-up innovation. We have indicated that a collective approach to cross-sector open data initiatives can increase social capital and exploit the long term benefits and value of a social system like a smart city. Open data between sectors and across the quadruple-helix actors is a vital enabler of a holistic smart city that is capable of breaking down the silo-thinking and finding new opportunities, which can sustain or increase the collective long-term value of the system.

Sustainability is neither a well-defined concept but in our context it makes sense to include and relate to the definition *sustainable development* by Hilty and Aebischer (2015):

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (Hilty and Aebischer, 2015, p. 3)

Even though it rapidly becomes a theoretical exercise, it seems relevant to acknowledge that decisions regarding sustainable development in smart cities have to consider the future needs of all sectors. Our argument is that open data can link these sectors and provide a synergy, which allows smart city actors to participate in the city

6

development and gives stimulus to a respect for the future of each other. This is a pragmatic, systematic approach to comprehend the wicked problems caused by the increasing urbanisation and industrialisation.

Here is a summary of the two deduced presumptions explaining why open data is relevant in the smart city context:

- **Presumption 1:** Open data has a potentially democratising effect which brings all smart city actors together to allow collective decisions and the development of holistic smart city solutions, which enable sustainable development in the long-run.
- **Presumption 2:** Opening up private and public data in a collectively decided way can lead to cross sector innovation and function as an enabler of other smart city innovations/solutions aiming for long-term sustainability.

1.1.3 Smart city maturity concerning open data

If we recall what Jensen (2014) writes, there is a huge difference in the ability to cross-sector thinking among smart city actors. Even though some actors, it can both be public or private, want to challenge their own field and seek possibilities in other fields, they are locked-in to their own field because of a fundamental resistance in the rest of the ecosystem towards sharing ideas and get out of their own "silo-thinking". Obviously there is a critical absence of incentive structures to evolve and improve the smart city ecosystem enabling actors to harvest the value lying in between sectors. We define this as dis-harmonic levels of maturity among smart city actors towards holistic decision-making. Open data is a means to use data as a strategic resource, which can increase the tangibility of the potential cross-sector value.

We want to draw a parallel to the organisational field of Enterprise Architecture (EA) without going too much in depth with its definition. EA has shown that holistic thinking and coherent views on data and IT management can increase the agility of organisations and create synergies across departments and branches (Jonkers et al., 2003; Ross et al., 2006). While the introduction of IT in business development has opened up for a lot of opportunities and broken down market barriers, companies are at the same time getting locked-in to non-expandable IT architectures. This happens because of a typical insular approach to business IT development where opportunities are not sought outside the familiar domain (Ross et al., 2006, p. 72). This is commonly described as low level of EA maturity.

Ross et al. (2006) have identified a certain path of development regarding the approach towards using IT in internal/external business solutions. They say that companies tend to think in *business silos*, which corresponds exactly to the short-sightedness Jensen (2014) identifies in public/private sector data collaboration.

Figure 1.3 shows how 25% of firms create locally optimal business solutions without reflections about how cross-branch solutions can create company-wide business synergies. This model can be used by enterprise architects to measure the maturity-levels of a company and by that come with suggestions to increasing the maturity.



Figure 1.3: Architecture Maturity Stages (Ross et al., 2006)

And so, this is a generalising model that is used to lump the characteristics of modern companies all together. Of course, such a model can be criticised from an interpretive perspective for being blindly generic, but in fact the generalisation gives a simplistic and useful picture for future decision-making even though individual characteristics cannot be taken into account. They write that

"the role of IT in the the Business Silos stage is to automate specific business processes. Thus, IT investments are usually justified on the basis of cost reductions. [...] IT develops or buys an application to fully meet the requirements. [These] applications align naturally with a company's business unit, functional, or geographic structures. [...]. These one-off solutions, however create a legacy of systems that cannot talk to each other." (Ross et al., 2006, pp. 72–73)

In the long run this mindset and lack of holistic thinking (low maturity level) inherently prevents innovation. This behaviour is not sustainable in the way we defined it in subsection 1.1.2. We draw a parallel between EA maturity and open data maturity in a smart city context; there is a possible need for a maturity model or framework like the one by Ross et al. (2006), fig. 1.3, which can enhance the collective approach towards open data initiatives with cross-sector sustainability as the fundamental goal in a smart city.

1.2 Research Question

How can we make a conceptual maturity model for assessing open data maturity of a smart city ecosystem, which normatively can function as a guideline for relevant actors?

- Subquestion 1: How can open data be used as a sustainability-enabler in the context of smart cities?
- Subquestion 2: What are the most important incentive structures for attracting support for such a model among smart city actors?

1.3 Research Objectives

Our main goal of this research is to take a methodological approach that enables us to answer the research question. We want to utilise a well considered method to create a conceptual maturity model with a normative nature. A normative model is one that prescribes or relates to the norm for how something should be or behave (Colman, 2014) and therefore it is important for us to capture ideal and interdependent actions that can lead to increasing the open data maturity in a smart city. Therefore it is also vital for us to investigate and elaborate on the concept of open data maturity of a smart city ecosystem. We have not been able to find contemporary research that takes a normative approach to any aspect of smart city maturity and our hope is to fill that gap and illustrate a possibility to simplify the smart city ecosystems and provide generic guidelines.

Another objective is to understand how open data can be used as a sustainabilityenabler in smart cities and we hope to be able to find answers to this during our analysis. It requires that we do a thorough literature review on the concept of sustainability and develop an understanding of it as part of an empirical data analysis. The objective of subquestion 2 is to understand which incentives structures are needed for smart city actors to collaborate and share data. We hope to be able to unveil some general behavioural mechanisms among smart city actors and find out how to facilitate those mechanisms that attract support for collaboration. Maturity is the focal point of our research.

1.4 Research Significance

The relevance and significance of our research is exemplified in the both national and international contexts. On an overall level there is an increasingly realised need to seek collective decisions and strategies in order to be sustainable both economically, socially, and environmentally.

The European Commission has, in the already mentioned communication to the European Parliament, addressed how open data can be means to tap economic opportunities and tackle societal and environmental challenges (European Commission, 2011, p. 3). They point out that one main EU open data achievement is the preparation and deployment of the *Directive on the re-use of public sector information* (European Parliament, 2013). There is, however, a *"lack of awareness among public*"

organisations of the potential of open data" (European Commission, 2011, p. 7). We argue that the following quote clearly illustrate the significance of our research:

"Changing the mindset in administrations requires strong political commitment at the highest level and a dynamic dialogue between stakeholders, including administrations and public data holders, businesses and the academic community. Pilot and test cases, the sharing of good practices, and mobilisation campaigns (using for example open data competitions) can help the public sector in adopting a culture of open data. This will also increase business awareness of data availability and the opportunities it offers." (European Commission, 2011, p. 7)

In addition, our research hopes to establish an environment for overcoming the practical and technical issues to be addressed. They write that "data interoperability aspects need to be tackled so that information resources from different organisations and countries can be combined" (European Commission, 2011, p. 8). We see this tackling as part of a maturing process, where sustainable data interoperability is more likely to be obtained by going through other necessary steps.

The Prime Minister of Denmark, Helle Thorning-Schmidt, and the Danish Minister of Economy and the Interior, Morten Østergaard, recently wrote a feature in the national newspaper Politiken. They emphasised how collective welfare is a product of sustainability-enabling policy:

"We can not keep off affecting our environment when our agricultural businesses produce food and we, for instance, build new roads and railways. But we must find the right balances, where economic growth and social development occurs in interaction with - and not at the expense of - our nature and environment." (Thorning-Schmidt and Østergaard, 2014)

This can be seen as an attempt to create common national values and goals, which can enable collaboration and catalyse synergies increasing the total value of the system.

Along with Great Britain, the Danish government has also developed ideas and publications about how to utilize open government data in an e-governance context. In October 2012 they published the e-governance strategy for 2011–2015 called "Good Basic Data for Everyone - a Driver For Growth and Efficiency". They write about how "public authorities in Denmark register various core information about individuals, businesses, real properties, buildings, addresses, and more," (The Danish Government / Local Government Denmark, 2012, p. 3) and outline their visions for enabling re-use of this data and point to the obstacles the society has to overcome for it to happen. They say that there are not clear incentives for the sectors to use the resources needed for sharing their data and the price of this data is very difficult to determine because of conflicting interests among the public sector and private entrepreneurs and businesses who want to exploit public-sector basic data in new and creative ways (The Danish Government / Local Government Denmark, 2012, p. 4). The following quote supports the relevance of our research. The goal of our research is exactly to normatively grasp and reach a sustainable exploitation of cross-sector open data - not limiting it to only public data.

"Open and homogeneous re-use of basic data also has great value for the private sector, partly because businesses use this data in their internal processes and,

partly, because the information contained in public-sector data can be exploited for entirely new products and solutions, in particular digital ones. In short, basic data freely available to the private sector is a potential driver for innovation, growth and job creation." (The Danish Government / Local Government Denmark, 2012, p. 3)

The Danish consortium CLEAN³ is also engaged with the open data agenda in Denmark - particularly in a smart city context. Recently they published an issue of their journal called "Cities - the real climate heroes?", where they draw attention to smart cities and see them as catalysts for green development. Schultz (2013b) says that long-term planning requires new forms of collaboration and CLEAN has also made an effort to investigate new collaboration forms through their consortium. They have drawn attention to the potential value of cross-sector open data initiatives and put out a tender for what they call *Big Data Infrastructure*⁴. The tender documents was made public in October 2013 and asks for suggestions to business models, incentive structures, pilot apps, etc. The platform is thought as a platform for transactions of public and private data with a vision of being financially sustainable and give private actors opportunity to draw value from existing data⁵. They write that

"Private companies are not aware of the value of their data because the potential buyers are not aware of the data's existence. By creating a platform where the two sides can work together it creates an 'information market', which will foster innovation and create new services to consumers."

We argue that for such a platform to be successful and yield most long-term, sustainable value, actors have to develop a collective mindset and a common vision regarding the platform. Of course, the platform itself can catalyse open data maturity among actors, but has no built-in mechanisms for ensuring it. Our research put this kind of concrete initiatives into a broader perspective with a goal to increase the probability for open data initiatives to become successful. If we, through this thesis, can validate the advantages of using a systems approach in smart cities and succeed in forming a conceptual model for normatively increasing the collective open data maturity of a smart city, then our research is state of the art.

1.5 Reading Guide

This introduction included a preliminary small literature review to make the reader understand our initial pre-understanding of the subject matter and how that justifies our research question and objectives. In chapter 2 we will provide an in-depth literature review outlining contemporary research around the topics of smart cities, sustainability, data, and maturity.

In chapter 3 we will present theoretical literature which will consist of generic theoretical concepts and frameworks that we can use as well-founded background research to elaborate on answers to our research question. This theory provides us with a certain bias that we can use to understand and work with the subject matter.

³Formerly known as Copenhagen Cleantech Cluster.

 $^{^{4}}$ In chapter 2 we will give an overview of the differences and similarities between the two concepts of open and big data.

⁵http://cleancluster.dk/projekter/big-data-infrastruktur-innovativ-udbudsproces/

In chapter 4 we will elaborate on our research philosophy and methodological decisions that lead to a certain way of collecting, understanding, and working with empirical data.

In the analysis, chapter 5, we will do an extensive analysis of our empirical data on the basis of our methodological decisions by using the theoretical framework and literature review as our knowledge references. This will provide us with structured findings that can be used in the discussion, chapter 6, to answer our research question and elaborate on future research.

The conclusion, chapter 7, will include a summary of our findings and answers to our research question. We will also assess the extent to which the results of the research can be regarded as successful.

Chapter 2

Literature Review

Research must be positioned in relation to the existing body of literature and build on previous research done on the subject (Kuada, 2012). As mentioned in section 1.1, we use this literature review for two primary reasons: (1) to make a clear outline of the subject matter and show the reader the contemporary research in related and surrounding areas and (2) to build a strong justification for our research - that is both our research question and our research approach.

The formulation of our research question is a result of this effective analysis of the existing literature, which has sharpened our attention towards this specific choice of topic. Our choice of theoretical framework, presented in chapter 3, has been chosen on the basis of our gained knowledge from this critical literature review.

In this chapter we will look into literature regarding four main concepts that underpins our research area. Those four concepts are:

- Smart cities
- Sustainability
- Data
- Maturity

The chapter begins with the description of the core concept of smart city elaborating on its characteristics and components. After that, we will look in to the relation between the smart city characteristics and components and how these relations help to develop achievable smart city initiatives. Secondly, we will discuss the concept of sustainability and its various aspects. On the basis of available literature we will review the relation between the smart city and the 'sustainable city' and we will also elaborate on how the concept of smart city embraces sustainability in itself. Thirdly, we will look into how different smart cities have utilized the potential of open data and how laggards can get some incentives from those cities. This will lead to a description of the role of open data in developing smart cities. We will provide some insights to ecosystem formation in the development of a cross-sectoral open data platform. Finally, we will outline the potential need for a maturity model that can help in the formation of an ecosystem, which is capable of levering the full potential of open data and hence developing a smarter city.

2.1 Smart Cities

In last few years the term 'smart city' has become very popular among the policy makers, city leaders and practitioners. And the possible reason for the popularity is that the concept of smart city has been seen as a possible solution for the problems arising due to increased urbanization:

"The increased urbanization puts pressure on the city infrastructure and service delivery and complicates environmental, economic and [Social] growth, while digital and pervasive technologies increasingly challenge notions of space, place and how we experience the city." (Korsgaard and Brynskov, 2012)

2.1.1 What is a smart city?

Before getting into the core discussion about the concept, characteristics, and challenges of smart cities it is important to elaborate on the definition of a smart city. Lots of smart city definitions have been proposed by different public and private organisations and most of these definitions are descriptive rather than being normative. Moreover, these definitions are mostly based on specific areas (technology, business, or environment) according to the convenience of its use. Some researchers define a smart city as a digital revolution promoting pervasive integration (Dameri and Rosenthal-Sabroux, 2014, pp. 90–91), while others take a more social approach. Hollands (2008) describes this as a *self-congratulatory* tendency due to lacking precision in the definitions. For our understanding we will follow some of the literature that comprise smart city definitions in broader context.

Nam and Pardo (2011) define smart cities in a broader context where they conceptualize smart cities as a mix of three dimensions: technology, people, and institutions:

- The technology dimension can be clustered into six different definitions: the digital city, the intelligent city, the ubiquitous city, the wired city, the hybrid city, and the information city.
- The human dimension of people is described in four clusters: the creative city, the learning city, the humane city, and the knowledge city.
- The institution dimension has two different definitions: the smart community and smart growth.

Toppeta (2010) defines a smart city as a city where technologies (such as Web 2.0) can be combined with organisational processes to improve sustainability and the livability of people. However, it is also important to understand that the concept of smart city is not only limited to technological advancement; social factors also play a central role. Nam and Pardo (2011) identify a necessity of a socio-technical view on smart cities. Giffinger et al. (2007) provide a comparative definition of smart city by including various aspects of it. According to them, a city is smart when it is "[...] well performing in a forward-looking way in [economy, people, governance, mobility, environment, and living], and built on the smart combination of endowments and activities of self-decisive, independent, and aware citizens" (Giffinger et al., 2007, p. 11).

Considering the socio-technical and future oriented aspects, Schaffers et al. (2012) "call a city "smart" when "investments" in human and social capital and traditional (transportation) and modern (ICT-based) infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory government". Such definitions are more relevant to take into consideration as they intend to create balance between economic and social factors along with the change in urbanization trends and "they also serve to open the definition potentially to encompass smaller and less developed cities which are not necessarily able to invest in the latest technology" (Manville et al., 2014, p. 22).

Furthermore, Von Hippel argues that "to this, the notion of empowerment of citizens and "democratizing innovation" should be added" (Schaffers et al., 2012). Despite of all these subjective definitions and discussions, the complex behaviour and future of smart cities cannot be grasped in an overall definition. But, as defined in the paper issued by the European Commission (Mapping Smart Cities), "[a]t its core, the idea of smart cities is rooted in the creation and connection of human capital, social capital and information and Communication technology (ICT) infrastructure in order to generate greater and more sustainable economic development and a better quality of life" (Manville et al., 2014).



Figure 2.1: Fundamental components of smart city (Nam and Pardo, 2011, p. 286)

2.1.2 Components and characteristics of smart cities

As mentioned in the previous subsection, Nam and Pardo (2011) identify key components of smart cities and they re-categorize these components into three categories: technology, people, and institutions (Nam and Pardo, 2011, p. 286). Figure 2.1 illustrates the key conceptual components under each category.

Giffinger et al. (2007) identify important areas of activities that relates to the concept of smart city: *"industry, education, participation, technical infrastructure, and various 'soft factors'*" (Giffinger et al., 2007, p. 10). They also identify six core characteristics of smart cities. Each of these characteristics are defined by a number of factors. Figure 2.2 illustrates the six characteristics and their defining factors.

Figure 2.2 was developed as a comparative tool for ranking European medium sized cities. With this tool, a city can be analysed from different perspectives and the area that needs more attention or further development can be identified (Giffinger

et al., 2007). This model has also been proposed by the European Commission (Manville et al., 2014, p.26) for the comparative study of the smart cities. Manville et al. (2014) also argue that the characteristics outlined in figure 2.2 "point to the deployment of multi-dimensional strategies, which consist of many components and projects designed to be synergistic and mutually supportive" (Manville et al., 2014, p.27).



Figure 2.2: Characteristics and factors of a smart city (Giffinger et al., 2007, p. 12)

Manville et al. (2014) elaborate on the various smart city characteristics and we will briefly go through them:

Smart Economy

Smart Economy refers to increased productivity and advanced manufacturing where innovation acts as a key pillar in the development of new business models and sustainable businesses that are supported by ICT. It is also concerned with the creation of smart clusters and ecosystems and with the economical success of the city on local and international markets.

Smart People

Smart People refers to the provision of equal access to education and training that can improve creativity and foster innovation encouraging people to participate in the development of the city. This will increase the social awareness and create social interaction. Additionally, it is about providing people the necessary skills to work in an ICT-enabled environment.

Smart Governance

Smart Governance exist when relevant public, private, and civil actors can participate in decision-making and planning so that the city can function efficiently and effectively as a single organisation. ICT-enabled governance can be an effective way to achieve this. Smart Governance also leads to transparency by opening data, using ICT, and involving relevant stakeholders in participatory decision-making.

Smart Mobility

Smart Mobility refers to sustainable, safe, and efficient transportation systems, which can be achieved by the support of ICT. Smart Mobility is also about creating awareness among people regarding the usage of one or more modes of transport (non-motorised options). ICT can play a vital role in providing real-time information, which can be accessed by the public in order to save time and money and decrease environmental impacts.

Smart Environment

Smart Environment refers to energy management: re-use and resource substitution, sustainable urban planning, and reduction of pollution by developing waste management systems, better drainage systems, and water resource systems. Smart cities encourage efficient usage of energy by promoting new technological innovation that result in less consumption and high efficiency.

Smart Living

Smart Living in concerned with enhancing the quality of life of the citizens, which can be the result of ICT-enabled life styles, behaviour, and consumption. Smart Living is also about providing people a safe living environment with enough hospitals, good quality housing, and accommodation. Finally, Smart Living is related to social cohesion and social capital.

Relation between smart city components, characteristics, and initiatives

Components are those factors by means of which characteristics of smart cities can be achieved. It can be any activity, resource, and method which is performed to achieve certain smart city goals. Manville et al. (2014) conceptualize components as the building blocks of smart city initiatives. Cohen argues components to be "key drivers of specific characteristics, based on the specific challenges and needs a city faces with respect to that characteristic" (Manville et al., 2014, p.29). Moreover, these components can be either vertically oriented, i.e. supporting a specific characteristic, or horizontally oriented, i.e. supporting several characteristics, or have an enabling nature (Manville et al., 2014). Nam and Pardo (2011) adopt a holistic approach to categorise different key components of a smart city into three categories: "technology (infrastructures of hardware and software), people (creativity, diversity and education), and institution (governance and policy)" (Nam and Pardo, 2011, p. 286). The relationships between the components and the characteristics of smart cities are illustrated in figure 2.3.



Figure 2.3: Relationship between components and characteristics of Smart Cities. (Manville et al., 2014, p. 30)

The relationships between the components and the characteristics of a smart city can be both direct and indirect. Direct in the sense that a characteristic can describe the smart city initiative by depicting what it is about. It can also define the relevant components and their direct beneficiaries, while on the other hand, a characteristic can only act as a means for delivering components for reaching a specific goal. In this case, the initiative itself forms the reason for bringing people together to create new ways of collaboration (Manville et al., 2014, p. 30). In general, smart city initiatives address problems of common interest within the city. Manville et al. (2014) describe the role of initiatives in a smart city by saying,

"[T]he success of a smart city depends on the depth and effectiveness of targeted improvement within each area or initiative and on the coherence or balance of the portfolio of initiatives across the city" (Manville et al., 2014, p. 20).

In other words, the success of a smart city depends on the success of its initiatives. Chourabi et al. (2012) propose a comprehensive set of factors for understanding the concept of smart city initiatives. Based on these factors they also develop an integrative framework that can be used to assess the success factors of smart city initiatives. For this they set up eight clusters of factors and identify the challenges and strategies in each cluster (Chourabi et al., 2012, p. 2291). The eight clusters of factors are:

- Management and Organization
- Technology
- Governance
- Policy
- People and Communities
- The economy
- Built infrastructure
- The natural environment



Figure 2.4: Smart City initiatives framework. (Chourabi et al., 2012, 2294)

Figure 2.4 depicts the smart city initiatives framework where factors are highly interdependent. Furthermore, the inner factors of technology, organization, and policy have greater influence on the success of smart city initiatives in comparison to the outer factors, i.e. People, Communities, Economy, Governance, Natural environment, and Built infrastructure (Chourabi et al., 2012, p. 2294). Although different approaches are taken in establishing a framework for developing smart city initiatives, the complex nature of cities makes it challenging.

Some researchers still argue that a more detailed analyses of the management of smart city initiatives as well as descriptions of the underlying drivers are required to achieve the overall goal of smart city initiatives (Bakıcı et al., 2013, p. 138). The development of initiatives are influenced by different factors (size and demography, economic development, technology development, environmental policies, and other country-specific factors such as culture and political agendas) as different cities have different needs and contextual conditions (Neirotti et al., 2014, pp. 25–30). Although the development of smart city initiatives is a complex matter, proactive engagement and collaboration between knowledge institutions and public and private organisations could lead towards the development of a smarter city (Bakıcı et al., 2013, pp. 146-147).

For understanding the nature of such collaboration it make sense to look into the structure of a smart city and to identify the actors involved and their relationships. For this we will approach smart city from an ecosystem perspective.

2.1.3 The smart city as a complex ecosystem

Approaching smart city from an ecosystem perspective can be used to understand the different roles of smart city stakeholders and their relationships. Schaffers et al. (2012) describes smart cities as a complex ecosystems "where ensuring sustainable development and quality of life is an important concern" (Schaffers et al., 2012, p. 5). These ecosystems consist smaller ecosystems, each handling their own area. These areas can be healthcare, education, media, energy efficiency, environment, as well as safety and public services (Schaffers et al., 2012, p. 7). These areas operate in an ad-hoc manner, but to realize the full potential smart city initiatives rely on crossdepartment (cross-area) connections and scale (Clarke, 2013b, p. 7). According to Toppeta (2010), the city is a complex network of systems where cultural, economical, social, and geographic constraints of each city are distinct. So to describe a smart city, one should take a holistic approach by understanding these networks of systems (or relations between areas). Looking a city from system perspective can potentially provide a holistic approach for understanding the relationships and interaction between its parts and hence create solutions that are integrative rather than mostly reductionist (Newman and Jennings, 2008, p. 92). Furthermore, Newman and Jennings (2008) argue that implementing a system approach may help to develop sustainable solutions. They also depict the strengths of having a systems and ecosystem perspective (Newman and Jennings, 2008, p. 93):

- By focusing on relationships and processes, we gain better understanding of emergent properties and the complexity of living systems.
- Context is recognized as important, as parts cannot be studied in isolation from the other parts of the system and from the wider systems within which they are embedded. Ecosystems are nested, as we are nested within ecosystems- systems within systems, wholes within wholes.

The above statement depicts the necessity of understanding a smart city as a ecosystem, which helps to understand the relationships between different systems and also helps to explore new relations between these systems and by that form a new holistically integrated system. Furthermore, a city ecosystem consists of different stakeholders: city administrators, public and private bodies, citizens, and other active groups such as standardization bodies (Hitachi, 2013, p. 9). These stakeholders are motivated by their own interests, which is a main obstacle for *maturing* the smart city (as described in section 1.1) and having a collective approach in developing a smart city initiative. It seems critical to identify a way to mature the smart city actors for adopting collective approach in developing sustainable and holistic smart city initiatives.

Key Success factors in smart city development

On the basis of the reviewed literature it can be argued that smart city development is a never ending process. As the population increases the city needs to be more and more sustainable, efficient (regarding the use of resources), and robust (e.g. technology, economy). *IDC Government Insights* defines five best practice areas with the success factors within each area (Clarke, 2013b, p. 8). These five best practices have been categorised under two categories: non-technology and technology. Although Clarke (2013b) is reviewing smart city development from technological aspects, he explains how new technological development and innovation can lead to economic development, sustainability, and higher quality of life. Figure 2.5 illustrates the best practices within two categories and their key success factors.

Category	BestPractice Areas	Key Success Factors
Nontechnology	Strategy	 Vision: Specific social, economic, and environmental goals and objectives defined by city leaders based on citizen and business needs Leadership: High-level city leaders who drive the implementation of the vision Business case: The financial rationale for the vision
	Culture	 Innovation: How well a city experiments and innovates with new ideas and technologies Citizen engagement: How well a city uses citizens and stakeholders as resources (Open data is a foundation of engagement.)
	Process	 Governance: The structure for implementing change at the city level (organization, budgeting, performance measures) Partnerships: Levels and types of partnerships
Technology	Technology	 Architecture: Design of technology assets to be leveraged across city verticals Adoption: Penetration of broadband infrastructure and data capture devices like sensors, cameras, and so forth
	Data	 Use: Analysis and display of data for use for improved services and decision making Access: How data is shared and accessed by workers and citizens

Figure 2.5: Smart City Key Success Factors (Clarke, 2013a, p. 8)

These success factors must be addressed in mutual coordination with each other to effectively accelerate smart city development (Clarke, 2013b, p. 8). Use and access of data is seen as some of the key factors driving the smart city development. It also explains how embracing open data can create government transparency and potentially increase citizen involvement for solving complex issues within a city. Clarke (2013b) also provides an example of how different cities, like Barcelona and Seoul, have implemented these success factors and articulated a far-reaching vision. Furthermore, the paper also emphasizes that different government structures, like municipalities, can use ICT as the basis for development of better services, improved stakeholder collaboration, and greater efficiency and by that enable sustainable development of the city (Clarke, 2013b, p. 17).

2.2 Sustainability

The common understanding of the concept of sustainability is limited to environmental aspects but it does not only cover on environmental impacts. In most literature it covers the three aspects of environment, economy, and social well-being (Finkbeiner et al., 2010, p. 2). Jenkins and Bauman (2010) think in terms of models for sustainability where each model prioritize their own components. These models (economic, ecological, and political) are not mutually exclusive and often integrate with each other. In economic models "sustainability [is seen] as an investment problem, in which we must use returns from the use of natural resources to create new opportunities of equal or greater value" (Jenkins and Bauman, 2010, p. 383). In ecological models the main focus is on the health of the living world and in political models main focus is to sustain the social systems that realize human dignity (Jenkins and Bauman, 2010, p. 383). So, the definition of sustainability very much depends on the context or the lens through which one is looking.

2.2.1 Different types of Sustainability

Goodland (2002) identify four main types of sustainability:

- Human Sustainability: It means maintaining human capital, which include education, health, skills, knowledge, leadership, and access to services.
- **Social Sustainability:** Social sustainability deals with maintaining social capital. This includes the services and frameworks that create basic conditions for the society. Social sustainability is only possible in strong civil society. Government has the possibility to catalyse this. Commonly shared rules, laws, and information promote social sustainability.
- **Economic Sustainability:** In very general terms economic sustainability can be defined as the strategies for making efficient use of resources so that maximum value can be extracted from them. Some researchers also argue that economics values things in terms of money and by that has major problems in valuing natural capital (e.g. forest, healthy air, clean water). So, economic policies should be developed carefully using the precautionary principle routinely.
- Environmental Sustainability: Environmental sustainability means that the natural capital must be maintained. Natural capital consists of water, land, air, minerals, and ecosystem services. Environmental sustainability can support human sustainability and is generated by social concerns (social sustainability) but the traditional economic concepts are inversely proportional to the natural capital as much of the natural capitals are used to generate economic capital.

2.2.2 Smart cities, sustainability and sustainable development

Today cities are facing major sustainability challenges and there is a considerable need to change the way they function. The concept of smart city is seen as a probable solution for this problem as it enables the integration of smart technologies and thereby increases its efficiency, protecting its environment and inhabitants. Furthermore, the six characteristics of smart cities (section 2.1.2) also inherits all types of sustainability. Hitachi's Vision for smart cities also says that a smart city should be designed in a way so it incorporates a "*dynamic approach needed to ensure the sustainable existence of the city*" (Hitachi, 2013, p. 7). The FG-SSC (Focus Group on Smart Sustainable Cities) also argues that the issue of sustainability should be resolved within the urban landscape if we are to maintain and ensure development in the future. ICT can play a vital role in solving environmental, ecological, and economic challenges of cities globally.

"The FG-SSC acts as an open platform for smart-city stakeholders - such as municipalities; academic and research institutes; non-governmental organizations (NGOs); and ICT organizations, industry forums and consortia - to exchange knowledge in the interests of identifying the standardized frameworks needed to support the integration of ICT services in smart cities."⁶

The main task of this group is to analyse ICT solutions and projects that promote environmental sustainability. By combining sustainability with the concept of Smart City, FG-SSC has developed the concept of 'Smart Sustainable Cities', which they define as follows:

"A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects."⁷

The definition above depicts ICT as a major enabler of innovation in smart cities. The proper utilization of ICT in the economic sector catalyses new economic activities (Schaffers et al., 2012, p. 8) and increases the economic sustainability. More technology-oriented definitions see the smart city as a "place generating a particular form of spatial intelligence and innovation, based on sensors, embedded devices, large data sets, real-time information and response" (Komninos et al., 2013, p. 120). This also provides a room for more technological innovation that increases the quality of life and promotes sustainable development. Some researchers argue that the use of ICT enabled technologies changes the structure and processes of innovation and city development and hence more decentralized and bottom-up approaches to planning and innovation will be envisioned. Komninos et al. (2013) argue that innovation ecosystems are the major drivers for change towards smart city development. They further explain that

"innovation ecosystems are characterized by a mix of top down and bottom-up initiatives, leading to networking and collaboration among stakeholders, which eventually are extending to real innovation communities. Increasingly, citizens, advanced companies and local governments act as proactive catalysers of innovation, shaping cities as 'agents of change' " (Komninos et al., 2013, p. 121).

So smart cities have the potential to foster economic sustainability by promoting innovation. Furthermore, adopting a sustainability approach in cities depends on its characteristics. Cities with low GDP growth might require an affordable sustainable smart city development solution (Schultz, 2013a, p. 6).

⁶http://www.itu.int/en/ITU-T/focusgroups/ssc/Pages/default.aspx ⁷Ibid.

Sustainable development is considered as an *absolute concept* of sustainability (Hilty and Aebischer, 2015, p. 4). Moreover, it is about finding a balance between three pillars of sustainability: environment, economy and society (Hilty and Aebischer, 2015, p. 8). And so, a sustainable smart city should be able to create a proper balance between these three pillars. Additionally, the potential use of ICT-based innovation can solve the dilemma of sustainable development. While ICT can support sustainable development it also has a potential negative impact. For example, diffusion of ICT devices needs resources. Hilty and Aebischer (2015) explains this as *Jeavons' paradox or the rebound effect*. Although new technological developments can address the issues regarding sustainability in smart cities it is still unclear how ICT can support a creation of a long-term sustainable society by decreasing the rebound effects.

2.2.3 Open innovation for sustainable smart cities

The smart city can be seen as a laboratory for urban innovation where it invites people from the creative and digital economy, users, academics, local authorities, architects, and urban planners to rethink ways of approaching and transforming the city. It fosters development process based on open innovation in a real urban environment. With the emergence of smart city concepts, cities can be considered as innovation ecosystems that have the ability to conceive the collective intelligence of citizens for open innovation (Schaffers et al., 2011, p. 432).

The concept of open innovation has been quite influential in industrial innovation processes. Also, it is a decentralized, participatory, and distributed approach for innovation. A survey conducted by Forrester points out that "smart city solutions must start with the city and not with smart" (Komninos et al., 2013, p. 129). This indicates a necessity of a bottom up approach involves citizens in urban development processes. Ratti and Towsend explain the role of top-down vs. bottom-up approaches in the development of smart city initiatives. According to their explanation, "[c]entral planning often fails to create a city that is tailored to inhabitants' needs and makes too many unjustified assumptions about what people want. It also ignores the enormous creative potential of grassroots efforts and ignores the fundamental goals of social cohesion, quality of life, democracy" (Komninos et al., 2013, p. 130). By this, the authors advocates in involving citizens in the development process, which is possible due to the networking and communication technologies that are available everywhere Schaffers et al. (2012). Furthermore, Schaffers et al. (2011) explain the necessity of cooperation and collaboration between different smart city stakeholders in order to develop shared research and innovation resources that can form a platform for citizen/user driven innovation.

Different approaches such as testbeds, Living Lab facilities, and user communities are introduced to involve citizens and other stakeholders in smart city development (Schaffers et al., 2011, p. 444). Schaffers et al. (2011) see the concept of Living Labs as a way to evolve towards sustainable, open, and user-driven innovation ecosystems as they provide "opportunities to citizens and business to co-create, explore, experiment and validate innovative scenarios based on technology platforms such as Future Internet experimental facilities involving SMEs and large companies as well as stakeholders from different disciplines" (Schaffers et al., 2011, p. 433).

2.2.4 Factors driving the growth of sustainable smart cities

To understand the current development trends and possible future developments in smart cities, it is relevant to look into the factors that drives the growth of smart cities. Clarke (2013b) identifies some of the key trends that are drives the need for innovative approaches in city operations and service delivery (Clarke, 2013b, p. 2):

- Cities are in steadily increasing global competition for talent.
- Growing urban populations stress city infrastructure and resources.
- Climate departure makes energy efficiency an urgent issue.
- Cities must provide services that span the digital divide.
- Proliferating technology equals exploding amount of data.

Out of these trends, explosion of data is a tendency that gains much attention as many researchers see data as a new resource for sustainable development of cities. In section 1.1.1 we have already tried to depict the relevance of data in a smart city context and we will give a more detailed description in section 2.3. In most of the cases, advancing the development of smart cities is associated with data-driven innovation. For example, open data and sensor data can enable development of new services and upgrade existing services and thereby contribute to a smarter city. However, data itself does not constitute value. We want to scope our literature review into the area of data and figure out how it supports the creation and development of smart city initiatives.

2.3 Data

Due to the development in ICT and networks enormous amounts of data are generated. This data is generated from transactions, emails, videos, audios, images, click streams, logs, posts, search queries, health records, social networking interactions, science data, sensors, and mobile phones and their applications (Sagiroglu and Sinanc, 2013, p. 42). Human activities created 5 exabytes of data until 2003 but with the current technology developments this amount of data is created in 2 days. In 2012, the volume of data expanded to 2.72 zettabytes and it is predicted that this data will double in every two years and will expand to 8 zettabytes by 2015 (Intel IT Center, 2012, p. 3). Although it is a new resource, data in itself does not constitute value. Data should be processed into a useful pattern to get some value out of it. Big data and analytics can turn this vast amount of data into valuable and usable information and knowledge (Clarke, 2013b, p. 2).

2.3.1 Big data, Open Data and Open Government

Big data, open data, and open government are three different phenomena that can influence the development in different sectors (social, economical and institutional). Before getting into the core discussion about the relationships between these phenomena it is important to understand the concepts, at least from the basic definitions.

Big Data

"Big Data refers to huge data sets that are orders of magnitude larger (volume), more varied and complex (variety), and generated at a faster rate (velocity) than your organization has had to deal with before." (Intel IT Center, 2012, p. 3)

In general Big data is a term used to describe very large, complex, and rapidly changing datasets. But this is a subjective and technology dependent explanation. So, in the future with the advancement of technology and data analytics, today's big data may not be conceived as big.

Open Data

The notion of open data has been around for some years but it appeared in the mainstream when governments like UK, USA, Canada and New Zealand announced new initiatives for opening their public information (Dietrich et al., 2012, p. 3). But before getting much deeper in to the topic, it is important to understand what actually open data is. The *Open Data Handbook Documentation* by Dietrich et al. (2012) provides a clear definition of open data:

"Open data is data that can be freely used, re-used and redistributed by anyone - subject only, at most, to the requirement to attribute and sharealike." (Dietrich et al., 2012, p. 6)

According to Dietrich et al. (2012), data to be open should have following characteristics:

- Availability and Access: the data must be available as a whole and at no more than a reasonable reproduction cost, preferably by downloading over the internet. The data must also be available in a convenient and modifiable form.
- **Re-use and Redistribution:** the data must be provided under terms that permit re-use and redistribution including the intermixing with other datasets.
- Universal participation: everyone must be able to use, re-use and redistributethere should be no discrimination against fields of endeavour or against persons or groups. For example, 'non-commercial' restrictions that would prevent 'commercial' use, or restrictions of use for certain purpose (e.g. only in education), are not allowed.

Gurin (2014) provides a very simple and effective definition of open data by saying,

"Open Data can best be described as accessible public data that people, companies, and organizations can use to launch new ventures, analyze patterns and trends, make data-driven decisions, and solve complex problems." There is disagreement regarding whether open data is only be public data or if it covers the openness of data in general regardless whether it is coming the public or the private sector. Therefore it makes sense to distinguish between the concepts of open data and *open government data*.

Open Government

Open government is means to be a way to increase the overall government transparency. This openness in government "provide high-value information, including raw data, in a timely manner, in formats that the public can easily locate, understand and use, and in formats that facilitate reuse" (Yu and Robinson, 2012, p. 181). The ambiguity of open government makes the term Open Government Data (OGD) unclear, giving it a multi-meaning: one is politically important disclosures and the other one is "data that is both easily accessed and government related, but that might or might not be politically important" (Yu and Robinson, 2012, p. 182). Examples of OGD include large public-government datasets (weather data, GPS, Census, healthcare, etc.).

Bates (2012) argues that Open Government Data (OGD) has a progressive impact on the society and is positioned as a socio-economic initiative. Various countries have developed different OGD initiatives. These initiatives can range from community-led to World Bank sponsored, government led, and civil society initiated (Davies and Bawa, 2012, p. 1). The UK government is focused on using OGD initiatives to leverage its *marketisation* of new services (Bates, 2012). Similarly, more than 50 nations have participated in a partnership program called Open Government Partnership (OGP) whose objective is to promote good governance and strengthen democracy by increasing transparency, citizen participation, discussion with civil society, anticorruption, accountability, and the use of technology and innovation (The Danish Government, 2013, p. 2). The Danish Open Government National Action Plan 2013-2014 focuses on the use of new technology to strengthen transparency, growth, and the quality of life. It also focuses on a new approach to the role of the public sector where [the Danish Government] is to work on active and broad involvement of citizens, companies, and civil society in general" (The Danish Government, 2013, p. 4).

Janssen (2012) describes the relationship between OGD development with right-toinformation (RTI) movements. She argues that RTI and OGD are closely related but have different focuses and priorities. As described by Janssen (2012), OGD is mainly focused on "innovation and economic growth on the one hand, and efficiency of the public sector on the other.", whereas RTI is mainly focused on promoting "access to government information as a fundamental right". A similar subject is the re-use of Public Sector Information (PSI). To embrace the essence of OGD, EU developed a policy on the re-use of PSI called the PSI directive (Janssen, 2011; European Parliament, 2013). The PSI directive is economically inclined with no aims on regulating the matters related to access to government information. Janssen (2011) explains the blurry relationship between re-use of PSI and RTI as one of the reasons for reluctance in opening government data. So Janssen (2011) put emphasis on the necessity of including RTI and re-use of Public Sector Information (PSI) in the development open data policies.

We have already argued that a proper open government strategy promotes transparency and trust among citizens as well as the private sector. This leads to open governance strategies, which are concerned with the creation of proper institutions and effective rules and procedures for improving public service delivery (OECD, 2011). OECD (2011) defines governance in terms of relationships and thus views other public, private, and voluntary sectors as parts of general governance. In other words, open governance assures the participation of other sectors (citizens, private, and voluntary) and provides access to government information in order to engage its surroundings more effectively and respond to associated actors actively. Open governance strategies promote collaborative approaches where all the relevant sectors have the potential to be involved. Mutual understanding and sharing of information between these sectors leads to enhanced results.

2.3.2 Relation between Big Data, Open Data, and Open Government



Figure 2.6: Relation between Open Data, Big Data and Open Government (Gurin, 2014, p. 253)

Figure 2.6 depicts the relationship between big data and open data, and how they relate to the broad concept of open government. Gurin (2014) has highlighted some of the important aspects of big data and open data and argues that open data and big data "are very different in philosophy, goals, and practice".

- Big data is not democratic until and unless it is opened.
- Open data does not follow the same rule as big data i.e amount of data does not matter to be open.
- Big data can be data that is generated unintentionally and usually, data sources are passive whereas open data is generated with some purpose.
- Data is kept private in big data because of private or business reasons whereas data is made public in case of open data.
- When big data is turned in to open data, it is powerful and much more benefits can be realized. National weather data and GPS data provide an example of successful overlapping between open data and big data.

As to the relationship between open data and open government, open government take the advantage of open data by making the OGD machine readable and accessible and by that promoting transparency and accountability of the government (Yu and Robinson, 2012, p. 192). Similar to big data, the public sector can actually embrace the concept of open data and realize the full potential and benefits of the government data.

2.3.3 Open data as an innovation enabler

Open data has been identified as the worlds greatest free resource and it will drive the future economy. From different literature it is also clear that the necessity of opening up of data to build a better and sustainable society has been realized more or less worldwide (Gurin, 2014; Cerrillo-i-Martínez, 2012). Yu and Robinson (2012) identifies open data as a collaborative innovation approach and explains it by saying,

"when many individuals or groups are able to access information themselves and interact with it on their own terms (rather than in ways prescribed by others), significant benefits can accrue. Each of these movements are focused on certain classes of information, and each one leverages new technology to make that information more freely available and useful." (Yu and Robinson, 2012, p.188)

This also clearly depicts that open data leads to innovation that boosts development in different areas. Open data can be a powerful tool for unleashing new business and economic opportunities, addressing societal challenges, accelerating scientific progress, and creating a need to act at local, regional, national, or continental level (European Commission, 2011). Furthermore, opening up of data by an organisation or company helps to increase the economic benefits outside the organisation as well as inside the organisation because it makes it possible to cut some activities or handle them in more efficient manners and decrease transaction costs (Fioretti, 2010, p. 18). On the basis of high quality survey data collected from 138 Swedish IT-Entrepreneurs, Lakomaa and Kallberg (2013) present the importance of open data as an enabler and entrepreneurial activity and innovation(Lakomaa and Kallberg, 2013, p. 561). Open data can:

- simulate potential viability to ensure funding.
- provide information about potential market.
- reduce Development lead time to application market.
- drive innovation beyond applications.

• enhance existing online services and offerings.

They conclude that opening up of data provides tangible and direct pay off by increasing entrepreneurial activity and enhancing business services while not disseminating open data may lead to lost innovation and devalue new business plans (Lakomaa and Kallberg, 2013, 562).

2.3.4 Open data for sustainable development in smart cities

Open data has been realized as an enabler of innovation. It has been also viewed as a resource for innovation, growth, and transparent governance, which has a potential of leading Europe's economies to a high and a sustainable growth path (European Commission, 2011). Open data can support sustainable development by untapping new businesses and economic opportunities, addressing social challenges, and accelerating scientific progress (European Commission, 2011, pp. 3-4). The opening up of public sector information (PSI) alone can generate an estimated revenue of 40 billion Euro (European Commission, 2011, p. 3). Also, the societal value of open data increases its importance in a smart city context. Additionally, open data can also provide government transparency (as mentioned earlier) (Fioretti, 2010, p. 17). "[This] brings people closer to their representatives" (Howard, 2012, p. 5) and may also endow them with the opportunity of participate in governmental decision making processes.

By making government operations transparent and by involving people in governance processes solve complex problems faster and more effectively by harnessing the power of collaborative approach of the city actors. This can increase the quality of service and reduce investments of public resources (Lee et al., 2012, p. 150). Furthermore, Howard (2012) explains how open data can support sustainability in the context of smart city: open data can build trust, create accountability, build business, and create urban analytics such as for crime (Howard, 2012, pp. 6-7).

2.3.5 Reluctance in opening data

Despite of its remarkably high potential, the value of open data has not been realized optimally. Although some EU countries are making their public sector information available on *"transparent, effective and non-discriminatory terms"* other countries are reluctant to make their data publicly available (Janssen, 2012, p. 446). Fioretti (2010) identifies some of the reasons behind this reluctance (Fioretti, 2010, pp. 22-23),

- Lack of awareness about the importance and benefits of open data and lack of guidance and rules about the reuse of the data from the upper levels and fear to lose control acts as a motivation for doing nothing.
- Legal barriers or serious confusion about the legal status of data.
- Fear of embarrassment deriving from publishing low quality data.
- Lack of data maturity or low quality data.

To promote the dissemination of public sector information the European Commission adopted a PSI directive whose main aim was to encourage member states to open up data they created (Janssen, 2011, pp. 446-447). According to Janssen (2011), the PSI directive has been unable to solve the issues regarding access and re-use of open data. Janssen (2011) also emphasizes that the development of integrative information policies can catalyse the opening of data (Janssen, 2011, p.454).

Researchers argue that the reluctance in opening data is mainly seen among the public sector (Lee et al., 2012). This also might be the result of "silo trap: the inability of government bodies to share information and collaborate effectively across organisational boundaries (Bason, 2010, p. 90). Robinson et al. (2008) describe how federal rules prevent public bodies to keep the same pace as private organisations.

As described in section 1.1.2, both the private and public sectors are trapped into silo thinking. There is a need of *maturing* the these actors in regards to developing a collective mindset of opening data. This requires us to understand the concept of maturity and how it works.

2.3.6 Open Data Technologies

We find it necessary to briefly explain how data can be opened from a technology point of view. We will not go into depth with all the different mechanisms and protocols but just point to literature that explains some of the most widely used technologies.

Opening and sharing of data inherently involves the Internet as a sharing platform for structuring, publishing, finding, and exploiting certain information (Auer et al., 2007; Hofmann and Beaumont, 2005).

Data can be structured in the most simple way, such as in online PDF and text files. This type of static data is not very flexible in its structure and difficult to make dynamic, but in terms of secure communication it is very effective (Appendix A.4). The municipality of Copenhagen is publishing lots of data about the city on their website, http://data.kk.dk, mostly in CSV, JSON, and PDF files. It varies how often the data is updated but the most frequently updated datasets are updated every 24 hours (e.g. http://data.kk.dk/dataset/udlansdata. If the data is updated then it might be considered as dynamic but should not be confused with real-time data from sensors, data robots, other data collection mechanisms⁸.

One way to use open data as a platform for bringing together several groups of users and customers is through the use of open Application Programming Interfaces (APIs). API platforms have the possibility to reduce the transaction costs between its developers, customers, and end users (Mulligan, 2008, p. 25). A Web Service is a type of API that typically operates over HTTP but also over other communication protocols like SMTP (in the case of SOAP Web services)⁹.

⁸http://www.investopedia.com/terms/r/real_time.asp

⁹http://www.w3.org/TR/ws-gloss/



Figure 2.7: The Web Services Model (https://support.novell.com/techcenter/arti cles/dnd20030304.html)

Language Protocol	Role
UDDI —The Universal Description, Discovery & Integration specification provides a platform- independent way of discovering and describing Web services and Web service providers.	Discover Services and their High Level Description—What services are available?
WSDL —The Web Services Definition Language is a format for precisely describing network services in terms of ports, operations, message exchanges and data formats	Describe Services Precisely —What services are provided? What operations can be performed? What service ports provide access to those operations? What messages can be exchanged? What is the data format for each operation?
SOAP —The Simple Object Access Protocol is a lightweight protocol intended for exchanging structured information in a decentralized, distributed environment.	Exchange Messages—Exchange information between service ports described by WSDL.
XML—The Extensible Markup Language is a very general and extensible language for identifying the structure of data, including documents.	Define Data Structures
HTTP, TCP/IP, and other transport mechanisms.	Transport Data —Move information to and from the service.

Figure 2.8: Components of the web services architecture (Hofmann and Beaumont, 2005, p. 247)

The World Wide Web Consortium (W3C) defines a Web service as "a software system designed to support interoperable machine-to-machine interaction over a network. The interface to a specific Web service is described in a machine-processable format called Web Services Definition Language [WSDL]" (Hofmann and Beaumont, 2005, p. 247). In figure 2.7 a standard Web service model shows the web elements "that interwork to make up this Web-based paradigm for announcing, discovering, describing, locating, and exchanging messages to use the services" (Hofmann and Beaumont, 2005, p. 247). This model and modifications hereof can handle real-time data consumption and communication which relies on common open standards. We will not give an in-depth explanation of the standard Web service model but only point to the explanation given by Hofmann and Beaumont (2005) in figure 2.8.

Berners-Lee et al. (2009) emphasize that "raw dumps in formats such as CSV or XML sacrifices much of [the] structure and semantics [of the Web]". Linked data is a means to link, combine, and aggregate data entities on the Web (Berners-Lee et al., 2009, p. 1):

"In summary, Linked Data is simply about using the Web to create typed links between data from different sources. These may be as diverse as databases maintained by two organisations that, historically, have not easily interoperated at the data level. Technically, Linked Data refers to data published on the Web in such a way that it is machine-readable, its meaning is explicitly defined, it is linked to other external data sets, and can in turn be linked to and from external data sets." (Berners-Lee et al., 2009, p. 2)

The Linked Data principles can be used as a standard for open data and harvesting the value of data composition and combination. Berners-Lee et al. (2009) points to the Linked Open Data Project as a concrete example.

2.4 Maturity

Maturity is not a well-defined concept with a perfect consensus. There are many perspectives on how to understand this concept and how to work with it. In the following subsections we will outline the perspectives we find relevant to the subject of matter and explain its relevance to us.

2.4.1 EA maturity model – Ross et. al (2006)

In subsection 1.1.3 we briefly elaborated on what maturity is and its importance for enterprise architecture on an organisational level. We pointed to the maturity model by Ross et al. (2006) (figure 1.3) and it shows that organisations tend to think in *business silos* where they create locally optimal business solutions without reflections about how cross-department solutions can create organisation-wide business synergies and can strengthen the agility of the company to be more reactive/proactive towards external changes in its business environment.

This model can be used as a high-level assessment of the perception of their maturity. As a normative model it is not sufficiently detailed in its explanation of how to go from one stage to another, and so this is more like a descriptive model for organisation maturity concerning EA and IT development.

We have touched on their perception of maturity, which mainly is about the ability and willingness of the organisation to think holistically and to allow IT to be part of high-level strategic decision-making processes. Even though Ross et al. (2006) find themselves in a more low-level domain than we do (organisation-domain vs. city-domain), we find their thoughts relevant because of their emphasis on the responsiveness to global change which is ever important (Ross et al., 2006, p. 79).

"As companies migrate through the architecture stages, they shift from a focus on local optimization to global optimization. This evolution has important implications for organizational flexibility." (Ross et al., 2006, p. 79)

They also emphasise the importance, or rule if you will, of moving incrementally through the stages. It is simply not possible to skip maturity stages because of the major organisational changes encountered at each stage (Ross et al., 2006, p. 81). And so, it is an inevitable learning process to reach for holistic capabilities.

Level 0 10 11 12 13 1 2 3 4 5 6 7 8 9 Area c в A Defining architecture С B Use of architecture А c А в Involvement of business Involvement of development process в Involvement of operations в Relation to current situation Roles and responsibilities В Coordination of activities Controlling В D Quality management в С Maintenance architecture process в С Maintenance architecture deliverables в Commitment and motivation в Architecture roles and training А В Use of architecture method А в Consultation B Architecture tools Estimation and planning

2.4.2 EA maturity matrix – Berg and Steenbergen (2007)

Figure 2.9: Architecture Maturity Matrix (Berg and Steenbergen, 2007, p. 152)

Berg and Steenbergen (2007) have presented various ways to think about EA maturity in organisations. They write that a maturing process is often disturbed because organisations do not understand that not everything can happen at once.

"[Architects] must establish an overall vision and corresponding architecture but, at the same time, they are constantly called to resolve very specific issues. It is important for them to be involved in all decision-making processes, to be informed about new developments and to participate in projects. [...]. If the architects also have to spend time building their own knowledge and skills, is it then any wonder that they sometimes can't see the forest for the trees?" (Berg and Steenbergen, 2007, p. 82)

In fact, they identify the premise that not everything *must* happen at once in trying to develop a holistic mindset in the organization and a supportive IT architecture (Berg and Steenbergen, 2007, p. 87). Important factors must not be given equal consideration at all times. Not every factor is equally relevant at the beginning and "any given area need not be brought up to its full state of development right away. Different levels of maturity can be distinguished in each of the various areas" (Berg and Steenbergen, 2007, p. 87).

Therefore, priorities can be identified and set in correlation with each other. The result is a *maturity matrix* which is depicted in figure 2.9.

Such a maturity matrix can be used to constantly assessing the maturity stage of an organisation. At the same time it has a *normative* function in that it provides concrete guiding questions to how to incrementally mature the organisation.

The idea is that for every area there are three or four levels of questions that has to be undertaken to be able to move on. The organisation cannot increase to the next level without satisfactory answers to the affected and relevant areas. For example, if an organisation can answer Yes to level A questions in the areas of "Defining Architecture", "Involvement of Business", and "Commitment and Motivation" then they are in maturity level 1. If they are able to positively answer the level A or even B questions of the area "Defining Architecture", they still find themselves in maturity level 1. This ensures that all the areas are aligned with each other and the model reflect their interdependence. All the different levels of questions for the various areas can be found in pages 151–183 in Berg and Steenbergen (2007).

The normative approach to holistic organisational learning ensures a sustainable business environment which endeavour to become flexible enough to overcome global/external challenges.

2.4.3 Smart Cities Wheel – Boyd-Cohen

It seems relevant to include the *Smart Cities Wheel* by Boyd-Cohen, which can be seen in figure 2.10. We include this wheel because it it used by *Copenhagen Solutions Lab* in their *Copenhagen Connecting* project which is solely financed by the local government in the municipality of Copenhagen (Appendix A.5, 01:06:14).

We have not been able to find any publication about the smart cities wheel so we will refer to the Internet blog http://www.fastcoexist.com/ where Boyd-Cohen made a contribution elaborating on his idea (http://www.fastcoexist.co m/1680538/what-exactly-is-a-smart-city).

It is a very high level model identifying six key areas (blue colour) that have to be treated in a smart city solution. It might not be considered as a pure maturity model but more as a reference meta-model for smart city governance where the underlying assumption is that

"smart cities are not one size fits all. Yet, the smart-cities movement could benefit from frameworks like the Smart Cities Wheel that allow a common language to develop amongst citizens, city staff, mayors, and the private sector."

What we can take with us from this model is the three steps of successful smart city initiatives:

Step 1: Create a Vision with Citizen Engagement:

The smart cities wheel can be a great inspiration to the development of concrete projects that can get citizen support.

Step 2: Develop Baselines, Set Target, and Choose Indicators:

"Before creating numerical targets for achieving a smart city vision, it is helpful to actually benchmark where you are." Because of their uniqueness "cities must develop their own benchmarks and targets around areas of need and opportunity."

Step 3: Go Lean:

"Once a city has established quantifiable goals and selected the indicators to measure its progress, it needs to snag some early wins while also building plans for longer-term actions. [...] It makes sense for a city to start with a pilot project as a way to get feedback on their hypotheses"



Figure 2.10: Smart Cities Wheel (http://www.boydcohen.com/smartcities.html)

2.4.4 Smart City Maturity Model – IDC Government Insights (Clarke, 2013a)

IDC Government Insights has, by the help and influence of Cisco, developed a maturity model for their definition of smart cities, which is very technically oriented. It is interesting to see the obvious similarities between this maturity model (figure 2.11) and the one by Ross et al. (2006).

	Ad hoc	Opportunistic	Repeatable	Managed	Optimized
Key characteristic	Siloed	Intentional	Integrated	Operationalized	Sustainable
Goal	Tactical services delivery	Stakeholder buy-in	Improved outcomes	Prediction and prevention	Competitive differentiation
Outcome	Proof-of-concept and business case development via ROI from pilot projects	Cross-organization deployments and development of foundational strategy and governance	Repeatable success in project process and outcomes across multiple organizations	Enterprisewide strategy, process, data, and so forth bring improved service delivery via adaptive sen se- and-respond systems	Agility, innovation, and continuous improvement in service delivery bring competitive advantage

Figure 2.11: Smart City Maturity Model (Clarke, 2013a, p. 7)

The basis for smart city development is driven by emerging ICT innovations and Internet of Everything that can provide sustainable solutions for issues such as ageing populations, increasing urbanization, digital divide, and climate change (Clarke, 2013a, p. 2).

We will not describe all the five different stages but just point out the deep influence from the Enterprise Architecture maturity model by Ross et al. (2006). In stage 1 (Ad hoc) the city has a siloed mindset and that means they can only set tactical goals and have proof-of-concept outcomes by means of department-based planning and discrete projects (Clarke, 2013a, p. 6-7).

"The initial reasons for Smart City investments $[\ldots]$ often begin with the need to reduce operational costs. IDC Government Insights finds that most cities are deploying these projects department by department $[\ldots]$ and using them to prove the business case for further investment." (Clarke, 2013a, p. 7)

When time goes by, the city finds out that smart city solutions are most effective when combined with other domains and departments and they increasingly go through each stage where stage 5 (optimized) is an almost unreachable vision, which is very similar to the Business Modularity stage in the model by Ross et al. (2006). Here a sustainable citywide platform is in place, which is "agile and based on continuously improving its strategy, IT, and governance that allow for autonomy within integrated systems of systems" (Clarke, 2013a, p. 6).

And so, this model is more descriptive than normative and can provide a clear picture of the overall maturity of the data-driven smart city. However, it cannot provide clear guidelines to the maturing process.

2.4.5 Open Government Maturity Model – Gartner (2010)

Already in 2010, Gartner published their Open Government Maturity Model, which is only available to their clients. We will refer to their blog http://blogs.gartner.com where they have posted a short description of it. The reason why we include it in our thesis is that it is intended for government CIOs and strategic planners and provides them with "a framework to measure the maturity level of their organization's capabilities to effectively and efficiently engage constituents and other stakeholders in transforming service delivery and operations"¹⁰



Figure 2.12: Gartner Open Government Maturity Model (http://tinyurl.com/2bzq99y)

This model (figure 2.12) shares many characteristics with figure 2.11 and figure 1.3 and the purpose is very much the same but this one addresses how to handle the complexities of Open Governance. It might indicate that Open Governance and data-driven smart cities touch upon the same problem domain. The maturity model

"consists of five levels, ranging from scenarios in which organizations are unaware of or denying the pressure for socialization and commoditization of processes, data and services, through to higher levels in which open government becomes a funded, enterprisewide strategy covering all relevant aspects of stakeholder engagement."

2.4.6 Open Government Data Maturity Model – Tauberer (2014)

The last contribution to the smart city maturity agenda that we want to present is actually the only one that specifically addresses open data. It is important to notice though, that Tauberer (2014) is only considering Open Government Data and not Open Data in a wider context. And so, this subsection goes in continuation of subsection 2.3.2.

Robinson et al. (2008) argue that a "[government] agency should first publish its data to encourage innovation in the private sector, which might develop services better than those the agency itself could". This is already the case today in some areas, for example in delivering weather data to private service providers that can compete in providing the best service on top of the data layer. Tauberer (2014) argue that a government agency also has the opportunity to make services based on their own

¹⁰http://blogs.gartner.com/andrea_dimaio/2010/06/28/gartner-launches-opengovernment-maturity-model/

data and the decision whether to provide raw data or a high-level service depends on the type of government data to be opened. The maturity model can be seen in figure 2.13.



Figure 2.13: A Maturity Model for Prioritizing Open Government Data (Tauberer (2014))

The rows depict different technological strategies of open government data and the columns are the different sorts of public information governments produce. The arrow shows how a government agency should choose a specific strategy when dealing with certain kinds of data - at first sight it looks like a roadmap for open government data. But actually it is a normative maturity model showing how a healthy data maturity process ideally should look like:

"the rows and the columns in this chart have an order. Some open government data projects should take precedence over others. Rows above should come before rows below. Columns to the left should come before columns to the right. (At least, roughly.) That makes this a maturity model in the sense that it outlines what proper growth looks like for government programs that implement open government data. Proper growth starts with freedom of information for laws and ends (if it ends) with public data on the semantic web. Don't run before you can walk." (Tauberer, 2014)

A thorough exposition of the model can be found at http://razor.occams.info/ pubdocs/ogdmatmodel.html.

Chapter 3

Theory

In this chapter we will present different theories that will form a basis for analysing empirical data and further point towards our discussion.

The theory is presented in the following order:

- Systems Theory
- Ecosystems Theory
- Institutional Design Theory
- Open Innovation Theory

3.1 Systems Theory

What we have leaned so far from the literature review is that we are engaging with many interrelated areas, which cannot be understood and dealt with without a more holistic perspective. There are of course more parts of this open data picture than what we have discussed in the literature review and a clarification is part of our learning process. Our attempt to attain a holistic view on a phenomenon and our hope to be able to understand the fundamental open data mechanisms can be explained in a systematic way by means of systems theory.

The fundamentals of systems theory have been hugely debated in the literature on various abstraction levels. The German sociologist Niklas Luhmann was known for his contributions to social system theory. Generally he sees a system as an abstraction defined by the boundaries between itself and its environment (Luhmann, 1982). As observers to a complex system, such as society, we can explain inherent subsystems by means of a well-defined set of variables, which can lead to a *reduction* of complexity. The selection of variables is a task of the observer and is based on his/her bias. The complexity reduction leads to a closed system that can be investigated and understood as such. On a very abstract, overall level, that is what we are doing right now in our research: We are choosing a scope (in our literature review and theory chapters) based on our current knowledge, which can help us with first establish a meaning of a part of a system, and then generalize, optimize and manipulate it. While Luhmann tends to be very abstract and apparently difficult to use in practice, Ackoff (1971) is more oriented towards making the systems concept concrete and usable. With his text "Towards a System of Systems Concepts" he has made a taxonomy for various occurrences of systems and subsystems in society. We will refer to this taxonomy while going through the concept of a systems approach to business and social sciences. As our main reference we will use Haaf et al. (2002), which is a descriptive and elaborating text about general systems theory.

3.1.1 What characterizes a system?

First we will present some overall working definitions of a system, which we can use in our research. One definition of a system is given by J. W. Gibbs:

"Any portion of the material universe which we choose to separate in thought from the rest of the universe for the purpose of considering and discussing the various changes which may occur within it under various conditions is called a system." (Haaf et al., 2002, p. 52)

And so it is about establishing some virtual framework conditions that allow us to study a phenomenon in a systematic way. They elaborate on that and define it as

"(1) a set of variables selected by an observer (Ashby) together with the constraints across variables he either discovers, hypothesises or prefers. Inasmuch as the variables of a system may represent the components of a complex machine, an organism or a social institution and a constraint is the logical complement of a relation, an equivalent definition of system is that (2) it represents a set of components together with the relations connecting them to form a whole unity." (Haaf et al., 2002, p. 53)



Figure 3.1: System Image Forming (Haaf et al., 2002, p. 54)

That means a system is something that is perceived as such from an observer perspective and it represents the logical correlations between its elements. If we look at the smart city as a social system then both definition 1 and 2 fit to our case. This is one way to approach city problems holistically and grasp the fact that a change in one part of the system inherently will affect another. Figure 3.1 depicts how the observer is forming a system image.

Ackoff (1971) also sees a system as "a set of interrelated elements [and] each of a system's elements is connected to every other element, directly or indirectly" (Ackoff,

1971, p. 662). That inherently means that there are some clear boundaries to the system and its environment. Haaf et al. (2002) have made a figure showing this (fig. 3.2).



Figure 3.2: Symbolisation of the concept 'system' (Haaf et al., 2002, p. 55)

Examples of social systems are e.g. (1) a department within an organisation, (2)a team within a department, or (3) the heart within a human being. In all cases the system of matter is somehow defined by its environment, context, or superior system. 1 and 2 are examples of *abstract* systems whose elements are concepts. "In an abstract system the elements are created by defining and the relationships between them are created on assumptions" (Ackoff, 1971, p. 662). 3 is an example of a *concrete system*, whose elements are objects. Smart cities and open data are concepts but it seems relevant to incorporate concrete objects into the open data system because IT infrastructures and architectures are inherent parts. As seen on figure 3.3 the subsystem is a selected amount of interrelated elements man body (concrete superior system).



Figure 3.3: Symbolisation of a subsystem (Haaf et al., 2002, p. 56)

within a superior system such as society (social, abstract superior system) or a hu-

3.1.2 Applying systems theory

We can see the paradigm of opening up data in the private and public sectors constituting a subsystem within the smart city, and a model for establishing a collective open data mindset shall consider, evaluate, and incorporate the open data system elements holistically. It is difficult to imagine how a complex system like a city can be conceptualised as such because of its infinite nature and limitless amounts of *wicked problems* (Rittel and Webber, 1973). In such case it might make sense to break it down until a tangible and systematically optimisable system appears.

When that state has been identified then the interdisciplinary approach to holistic, multi-aspect problem solving can happen in that subsystem (fig 3.4). One can refer to is as bottom-up system optimization.



Figure 3.4: An example of an interdisciplinary approach to a multi-aspect problem (Haaf et al., 2002, p. 63)

Of course it is a simplification of the wicked problems in a city but it is a way to finding a way into a complex black box. When we can determine the *reactions* and *responses* between elements in a system then we are able to evaluate system event and perform system changes (Ackoff, 1971, p. 664).

We might benefit from understanding the current open data system as a *multi-goal-seeking* system, which is "goal-seeking in each of two or more different external or internal states, and which seeks different goals in at least two different states" (Ackoff, 1971, p. 666). According to our research background, which leads to our research question, we presume or hypothesize (presumption 1 in subsection 1.1.2) that open data has the potential to bring smart city actors together to allow collective decisions and sustainable smart city solutions to evolve. To reach that state and harvest the potential value of open data we apparently have to strive for reaching a *purposeful* system which

"... can produce the same outcome in different ways in the same (internal or external) state and can produce different outcomes in the same and different ways. Thus a purposeful system is one which can change its goals under constant conditions; it selects ends as well as means and thus displays will." (Ackoff, 1971, p. 666)

A purposeful system typically has a common vision, such as an organisation with elements with common purposes. When talking about a social city system with conflicting interests among actors we have to strive for establishing a common *ideal* which they can work with and develop to harvest the value of a mutual opening of data. Such an *ideal-seeking* system is

A *reaction* of a system is a system event for which another event that occurs to the same system or its environment is sufficient. A *response* of a system is a system event for which another event that occurs to the same system or its environment is necessary but not sufficient (Ackoff, 1971, p. 664). "... a purposeful system which, on attainment of any of its goals or objectives, then seeks another goal and objective which more closely approximates its ideal. An ideal-seeking system is thus one which has a concept of 'perfection' or the 'ultimately desirable' and pursues it systematically; that is, in interrelated steps." (Ackoff, 1971)

3.2 Ecosystems Theory

The term *ecosystem* is often thought of as a biological description of how organisms are interlinked and keep an energy flow. Oxford's *Dictionary of Social Sciences* describe an ecosystem as "the complex relations among all organisms in a given area as a single biological system linked by flows of energy (such as the food chain)" (Calhoun, 2002). It is evident how the fundamentals of ecosystems are related to the systems theory described in the previous section.

A general ecosystem does not need to be either multi-goal-seeking, ideal-seeking, or even purposeful. To link it more to the taxonomy by (Ackoff, 1971) an ecosystem is an abstract system with certain reactions and responses which are not necessarily quantifiable. A specific kind of ecosystems has been identified in various literature as *business ecosystems*, which are similar to purposive systems. Typically a business ecosystem refers to an organisation instead of an organism and we hope to be able to justify the use of business ecosystem theory on a city level, or *ideal-seeking* system level.

In this section we will outline some general business ecosystems theory written by James Moore (1993). We will also use the text "Keystones and Dominators: Framing Operating and Technology Strategy in a Business Ecosystem" by Iansiti and Levien (2004) where business ecosystems are seen in a wider perspective and are linked to modern interdependent network industries. Fransman (2010) has written a book about the ICT ecosystem which is also relevant to elaborate on and compare to the business ecosystem theory. The hope is to be able use these theories to make our "open data/smart city system" more quantifiable.

3.2.1 Business Ecosystems

When one reads James Moore's introduction to the text "Predators and Prey" it is striking how the ecosystems approach fits to our holistic approach to smart cities. He writes that "innovative businesses can't evolve in a vacuum. They must attract resources of all sorts, drawing in capital, partners, suppliers, and customers to create cooperative networks" (Moore, 1993, p. 75). Cities might learn useful techniques from applying business ecosystems theory to their domain. The business ecosystem theory by Moore builds on the acknowledgement that

"... a company be viewed not as a member of a single industry but as part of a business ecosystem that crosses a variety of industries. In a business ecosystem, companies co- evolve capabilities around a new innovation: they work cooperatively and competitively to support new products, satisfy customer needs, and eventually incorporate the next round of innovations." (Moore, 1993, p. 76) This is exactly what we have identified as a necessary approach to the formation of sustainable open data solutions on a city level. A system such a city of course has social complexities that a typical business ecosystem does not match.

One major difference between business ecosystems theory and smart cities is the competition aspect. Moore highlights how business ecosystems compete against each other and says that "in fact, it's competition among business ecosystems, not individual companies, that's largely fueling today's industrial transformation" (Moore, 1993, p. 76) but such competition might not be beneficial for an open data environment that has to rely on commonly agreed standards and technologies. We want an ecosystem which can function as platform for other innovating and competing business ecosystems. And so one can conceptualise the city as a meta-ecosystem. Nevertheless, such a platform presumably requires a huge amount of ecosystem leadership and governance and therefore Moore's evolutionary stages of a business ecosystem are still very relevant for us:

"Whether that means investing in the right new technology, signing on suppliers to expand a growing business, developing crucial elements of value to maintain leadership, or incorporating new innovations to fend off obsolescence, executives must understand the stages that all business ecosystems pass through – and, more important, how to direct the changes." (Moore, 1993, p. 76)

	Cooperative Challenges	Competitive Challenges
Birth	Work with customers and suppliers to define the new value proposition around a seed innovation.	Protect your ideas from others who might be working toward defining similar offers. Tie up critical lead customers, key suppliers, and im- portant channels.
Expansion	Bring the new offer to a large mar- ket by working with suppliers and partners to scale up supply and to achieve maximum market coverage.	Defeat alternative implementations of similar ideas. Ensure that your approach is the market standard in its class through dominating key market segments.
Leadership	Provide a compelling vision for the future that encourages suppliers and customers to work together to continue improving the complete of- fer.	Maintain strong bargaining power in relation to other players in the ecosystem, including key customers and valued suppliers.
Self-Renewal	Work with innovators to bring new ideas to the existing ecosystem.	Maintain high barriers to entry to prevent innovators from building alternative ecosystems. Maintain high customer switching costs in or- der to buy time to incorporate new ideas into your own products and services.

Table 3.1 shows the four evolutionary stages of a business ecosystem according to Moore (1993):

Table 3.1: The Evolutionary Stages of a Business Ecosystem (Moore, 1993, p. 77)

Moore has outlined the cooperative and competitive challenges in each of the four stages. It seems mostly important to describe the cooperative challenges, while still remembering how to catalyse an environment for ecosystem competition. We will briefly go through each stage.

- Stage 1 Birth: In this stage you focus on finding out what customers want and how to deliver it. Moore writes that "victory at the birth stage, in the short term, often goes to those who best define and implement this customer value proposition" (Moore, 1993, p. 76). In this stage it is very clever to cooperate on finding common goals. Furthermore "a leader must also emerge to initiate a process of rapid, ongoing improvement that draws the entire community toward a grander future" (Moore, 1993, p. 79).
- **Stage 2 Expansion:** This stage is very much focused on the competition between ecosystems, which seems difficult for us to use. But an open data ecosystem also has to expand and the two conditions presented by Moore for successful expansion seem relevant:

"(1) a business concept that a large number of customers will value; and (2) the potential to scale up the concept to reach this broad market." (Moore, 1993, p. 79)

In our case the city (or whomever we identify) has to sell the open data idea and market it to relevant ecosystem participators. It has to understand that the survival of the ecosystem is depending on a successful adoption by its members. Stimulation of market demand is crucial for the ecosystem to survive this stage. Furthermore it is important to be aligned with suppliers so that they do not put constraints to the ecosystem development.

Stage 3 - Leadership: The leadership stage is met when you are the main determinant of the future of the ecosystem. When leadership is reached, one has to maintain a certain balance:

"First, the ecosystem must have strong enough growth and profitability to be considered worth fighting over. Second, the structure of the valueadding components and processes that are central to the business ecosystem must become reasonably stable. This stability allows suppliers to target particular elements of value and to compete in contributing them. It encourages members of the ecosystem to consider expanding by taking over activities from those closest to them in the value chain. Most of all, it diminishes the dependence of the whole ecosystem on the original leader." (Moore, 1993, p. 80)

And so it is in this stage that e.g. standards and interfaces are formed, which are inherently important for open data initiatives.

Stage 4 - Self-Renewal: The self-renewal stage is a token of the fact that ecosystems has to be flexible, agile and constantly developing to overcome certain external threats that requires new business structures and processes to be formed (Moore, 1993, p. 81).

The smart city as a networked industry

Iansiti and Levien (2004) are comparing business ecosystems to network industries and write that

"[i]n networked industrial environments [...], the performance of any organization is driven in large part by the characteristics and structure of the network, which influence the combined behavior of its many partners, competitors and customers." (Iansiti and Levien, 2004, p. 2)

Therefore they have identified the need for a framework describing the different ecosystem roles organisations deliberately or unknowingly undertake. This is one way to understand how ecosystems and how to make them sustain. We do not want to outline their whole framework in our thesis but just explain the relevance of their findings to our research.

They identify three main innovation and operations strategies in a business ecosystem, we can call it three different roles: *Dominator*, *Niche*, and *Keystone* (Iansiti and Levien, 2004, pp. 40–47). We especially consider the Keystones to be interesting for our subject matter and the thoughts of Iansiti and Levien (2004) will probably provide us with helpful considerations for the analysis.

"Keystones are the obvious regulators of ecosystem health. They are richly connected hubs that provide the foundation for creating many niches, regulate connections among ecosystem members and work to increase diversity and productivity. They provide a stable and predictable platform on which other ecosystem members can depend, and their removal leads to often catastrophic collapse of the entire system. They ensure their own survival and health by directly acting to improve the health of the ecosystem as a whole." (Iansiti and Levien, 2004, p. 40)

They provide the examples of big software companies like the Microsoft Corporation are controlling the Windows and .NET platforms (C#, Visual Basic, Azure, MSSQL, etc.), which form the foundation of a big percentage of the world's IT businesses (Iansiti and Levien, 2004, p. 41). They have to consider the whole ecosystem - 3rd party developers, companies, partners, competitors, hardware providers, etc. - for sustaining its keystone role.

But keystone examples are not limited to traditional technology industries, and so Walmart is an example of this. They have been successful in delivering real time sales information to its supplier network by means of its system called "Retail Link". They write that

"Retail Link became a supply chain hub that connected the systems of manufacturers like Tyson Foods or Proctor and Gamble to the retail channel, without having these providers connect to each individual store" (Iansiti and Levien, 2004, p. 42–43)

Walmart has established a low level open data platform with its basis in business ecosystems theory. It is of course beneficial for Walmart itself but also beneficial for manufacturers in that Walmart effectively provides a low-cost, high efficiency and information-rich platform for the sale and distribution of retail products (Iansiti and Levien, 2004, p. 43).

3.2.2 The New ICT Ecosystem

In book "The New ICT Ecosystem – Implications for Policy and Regulation", Fransman (2010) is treating the whole ICT sector as an ecosystem, which is of course our of our scope. The new ICT ecosystem refer to the set of complex business and innovation platforms based on the development of the Internet (Fransman, 2010, p. 1). We find his thoughts and conceptualisations relevant to our research because the narratives of smart city and open data are inherent parts of this ecosystem. The new ICT ecosystem is the superior system to smart cities and Fransman's elaborations on these external factors do matter to us and our research question.

Fransman is primarily focusing on the challenges of the European ICT sector to follow the pace of the rest of the ICT ecosystem, e.g. the ICT sectors in USA and Asia, which have regulatory frameworks that have enabled them to gain competitive advantage (Fransman, 2010, p. 5). He puts main emphasis on how to overcome these challenges, which is necessary for long term social and economic sustainability.

One way to address this issue is to empower the users of ICT and not necessarily the producers (Fransman, 2010, p. 5). An open data platform that have the ability to involve all important smart city actors as innovative users is beneficial for our competitiveness. Of course that requires a solid ICT infrastructure, which is indeed out of scope of this thesis. Another way to strengthen our ICT ecosystem is to provide a platform for basic and long-term research and open data have that possibility (Fransman, 2010, p. 6). Public and private research actors have to influence an open data ecosystem to ensure its sustainability. This is a way to exploit the heterogeneity of the different ICT sectors and derive value from it.

This quote actually can function as a justifier of our research:

"The identification of strengths, weaknesses and solutions for the new ecosystem in Europe requires appropriate conceptual and analytical frameworks. One of the initial assumptions motivating the present book is that a further challenge must be faced in honing the conceptual and analytical tools that we need for this purpose."

One important argument of Fransman's is that *"it is the ability to innovate that determines how well this new ecosystem will perform in different national contexts"* (Fransman, 2010, p. 13). Therefore we have included innovation and open innovation theory in section 3.4.

We can use the notion of symbiotic interdependence between ecosystem actors, which "may be mutually beneficial, although in some cases they may be harmful to one of the parties" (Fransman, 2010, p. 13). Again, one has to strive for a balance where the actors understand, accept, and benefit from their symbiotic interdependence.

The last point by Fransman that we want to present here is the nexus between innovation and investment. The formation of an ICT ecosystem cannot be funded by only one actor and Fransman writes that

"since investment is often necessary for innovation it is important that an effective innovation system and its modes of governance provide both an adequate supply of investment funds and the incentives necessary to encourage the investment that must occur to facilitate innovation." (Fransman, 2010, p. 19)

3.3 Institutional design for complex ecosystems

Cities are complex systems facing difficulties in social, economic, and environmental domains due to rapid urbanization (Schaffers et al., 2012, pp. 5-7) and the concept of smart city is seen as the possible solution for this. The behaviour of a city as a complex ecosystem has been presented in section 3.2. Although the concept of smart city is highly influenced by technological development, the importance of understanding institutional design in a complex system like the smart city is important. Furthermore, focusing on our research agenda, institutional design also plays a vital role in a complex technological system like an open data platform. Koppenjan and Groenewegen (2005) explains the necessity of considering institutional design in a complex technological system by saying

"[b]esides the design of the technological component, complex technological systems require an institutional structure that coordinates the positions, relations, and behaviour of the parties that own and operate the system. Aside from a technological design, an institutional design is also needed." (Koppenjan and Groenewegen, 2005, p. 241)

So, to answer our research question it becomes crucial to understand institutional design theory. In this chapter, we will describe the theory lying behind the institutional design and this will provide an understanding of the topic for further analysis and discussion.

3.3.1 Institutional Theory

A complex technological system (like an open data platform) consists of many stakeholders, so coordination between them is vital for it to function. This coordination between different parties can be established by implementing and fostering proper laws, policies, and norms. These implementations are regarded as institutions. Koppenjan and Groenewegen (2005) define institutions as,

"a set of rules that regulate the interaction between parties involved in the functioning of a (technological) system."

Scharpf provides a comprehensive definition for institutions. He defines an institution as,

"[a] system of rules that structure the course of actions that a set of actors may choose" (Koppenjan and Groenewegen, 2005, p. 244)

This also points out that not every set of rules or norms form an institution. Instead it has to be accepted by all the actors involved and should be practical and durable. Although institutions play a significant role in the functioning of complex technological systems, designing such institutions is not easy. Furthermore, "*[institutional]* design cannot be a 'blueprint' created through an intellectual process by a designer behind a desk" (Koppenjan and Groenewegen, 2005, p. 242). So a design process is necessary for developing an institution for a complex technological systems. Koppenjan and Groenewegen (2005) formulate this as 'process design' and elaborates on it by saying, "[a] process design consists of the whole of agreements and provisions aimed at the organizations and course of the design process" (Koppenjan and Groenewegen, 2005, p. 243)

So in case of open data the institutional design should be preceded by a design process that describes the process for development of institutional design. Lack of proper attention in process design may lead to vague institutional design and this creates 'cooperation problems' as well as 'the problem of collective action'. Koppenjan and Groenewegen (2005) defines collective action as,

"a multimotive game [where] there is no overall goal, but each party has its own reasons to participate and because each party is performing rational rent-seeking behaviour (each party makes calculations in order to pursue its own interests), there are considerable costs and risks involved in the decision to join."

This creates distrust among the stakeholders and deincentivises other actors to participate in the development of a technological system (like an open data platform).



Figure 3.5: The four-layer model: levels of institutional analysis (Koppenjan and Groenewegen, 2005, p. 247)

Based on the knowledge we have gathered till now, it make sense to claim that a proper institutional design is needed for an open data platform (system). Koppenjan and Groenewegen (2005) provide more specific details about the institutions depending on the functioning of complex system. They define it as the 'four-layer model', where the first level is of individual actors and the interaction between them; the second layer consist of formal and informal institutional arrangements that include

formal and informal laws, contracts, and norms; the third layer consists of formal institutions like formal laws and regulations; and the fourth layer consists of informal institutional environment like culture, values and attitudes.

Figure 3.5 depicts the four-layer model. This model illustrates that in a complex technological system the lower level institutions are constrained by higher level institutions whereas the higher level institutions are influenced by the lower level (Koppenjan and Groenewegen, 2005, p. 247-248).

3.3.2 Metamodel for Institutional Design

After understanding the role of institutions and further specifying different institutions at different levels of a complex system, it becomes important to understand how these institutions are designed. Koppenjan and Groenewegen (2005) provides a metamodel for institutional design. This model is a generic model and forms a heuristic tool for the development of design process, or at least it provides the conception of what logical steps should be taken to make an institutional design of a complex technological system.

Figure 3.6 illustrates the design process for developing institutions. One should be careful while designing in practice, "preferably working with testing prototypes (pilot projects), piecemeal engineering (which enables learning), providing alternative possibilities, and using experts and stakeholders" (Koppenjan and Groenewegen, 2005, p. 255).



Figure 3.6: The metamodel: a generic model of the design process (Koppenjan and Groenewegen, 2005, p. 252)

This theoretical approach will enable us to understand the role of institutions while working with an open data/smart city system and depicts how different institutions influence the functioning of such a system.

3.4 Open Innovation

The relation between open innovation and smart city ecosystem is significant. Cities have been realized as a platform for innovation. Moreover, with the open innovation paradigm, different governmental organisations are encouraging experiments for setting up user-driven open innovation environments (Schaffers et al., 2011, p. 432). Schaffers et al. (2011) describe cities as innovation ecosystems "empowering the collective intelligence and co-operation capabilities of user/citizen communities for designing innovative living and working scenarios." So, in this section we will introduce the general concept of open innovation to provide a common understanding of the concept.

The notion of open innovation has been realized to be of high relevance with smart city paradigm. The smart city is considered as an environment for open innovation, where the government, citizens, industries, and academics can have more open and networked forms of collaboration. According to Henry Chesbrough, the concept of open innovation is not only limited to industry but also extends to the relationships between the government and other institutions within the society (Paskaleva, 2011, p. 158).

3.4.1 From Closed to Open Innovation

In general, innovation is an origination of new ideas, products, or processes. Successful innovation can be obtained by managing uncertainties and these uncertainties can be minimised by having two types of knowledge: "knowledge on customer and market needs and knowledge on (technologically) possible solutions" (Wittke and Hanekop, 2011, p. 32). Customers are viewed as sources of information for innovation. This also goes hand in hand with the concept of encouraging citizen involvement in developing smart cities, where involving citizens will help to understand their needs. Furthermore, "[t]he new bottom-up approaches based on user-generated content, social media and Web 2.0 applications" (Paskaleva, 2011, p. 158) provides the user with modes for involvement.

In the traditional industrial world, innovation was based on internal research and development (R&D).

The internal R&D was valued as a valuable resource for new innovations and was also used as a powerful tool to retain monopoly (Chesbrough, 2003, p. 35). The development of a product was done within the boundary of a firm. So, the large corporations with big large R&D infrastructures were able to stay competitive in the market. Chesbrough (2003) developed the "Closed Innovation Model", which "calls for self-reliance: If you want something done right, you've got to do it yourself" (Chesbrough, 2003,



Figure 3.7: The Closed Innovation Model (Chesbrough, 2003, p. 36)

p. 36). Figure 3.7 depicts the closed innovation model. In this model "[...] a company generates, develops, and commercializes its own ideas. This philosophy of selfreliance dominates the R&D operations of many leading industrial corporations for most of the 20th century" (Chesbrough, 2003, p. 36).

This of course hindered the start ups with limited resources to get in to the market. But the growth of private venture capitalist and the movement of the knowledge professionals led to the erosion of closed innovation and hence a shift towards the open innovation paradigm (Chesbrough, 2003).

The concept of open innovation is based on the sharing of ideas, knowledge, and resources. Chesbrough (2005) defines open innovation as,

"the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively."

So, open innovation advocates that valuable ideas can both come from inside or outside the organisation and also get to the market from inside and outside the organisation. The Internet is one main enabler of open innovation and open APIs are concrete methods to realize this.

Figure 3.8 depicts the open innovation model by Henry Chesbrough. The main difference between the open and closed business model is that there is easy movement of innovations, both inside and outside the company. This is represented by a dashed line in the figure 3.8.



Figure 3.8: The Open Innovation Model (Chesbrough, 2003, p. 37)

The open innovation paradigm justifies two main anomalies of closed innovation paradigm (Chesbrough, 2005, p. 5).

- In the closed innovation paradigm it was difficult to capture the value of spillovers generated from industrial R&D and it was regarded as the cost of doing business but in open innovation paradigm these spillovers are viewed as an opportunity to bolster a company's business model.
- In the closed innovation paradigm intellectual property was protected as a company's valuable assets

and not much value was generated, but in the open innovation paradigm intellectual property adds additional revenues to the current business model.

So, in our research context, data can be seen as generated spillovers, which can create extra value (both economic and social) when being opened up.

After understanding the concept of open innovation, it is also important to understand the development process of open innovation.

3.4.2 Steps in developing open innovation

Chesbrough (2003) depicts three main areas for the development of open innovation and argues that companies mainly focus their activities in these three areas:

Funding Innovation

"Innovation investors and benefactors" are focused on providing funds for innovation. Innovation investors can be "corporate $R \ensuremath{\mathcal{CD}} D$ budget, venture capital firms, angel investors, corporate VC entities, private equity investors e.t.c." (Chesbrough, 2003, p. 38) Innovation benefactors are focused on early research about the innovation.

Generating Innovation

Four types of organisations are identified in this area. They are: "innovation explorers, merchants, architects and missionaries." Innovation explorers are mostly focused on finding out about the innovation. Innovation merchants are focused on actual development of the product and with that they innovate for some economic benefits. Innovation architects are those providing valuable services in a complex technology world. "To be successful, innovation architects must establish their system solution, communicate it, persuade others to support it and develop it in the future" (Chesbrough, 2003, p. 39). At last, innovation missionaries are like welfare organisations that innovate to serve a cause and are not motivated by economic benefits.

Commercializing Innovation

Two types of organisations are identified in this area. They are: "innovation marketers and one-stop centres." Innovation marketers have some of the characteristics of other organisations but their main function is to create beneficial market ideas. Marketers understand the market needs and support innovation. "To this day, a number of companies, called 'fully integrated innovators', continue to espouse the closed innovation credo of 'innovation through total control'" (Chesbrough, 2003, p. 40)

3.4.3 Open innovation in the public and private sector

Open innovation has been viewed as a new paradigm with possibilities for good and efficient development because of its characteristics of sharing resources and knowledge (Lee et al., 2012). This new innovation paradigm has highly influenced the private and public sector by facilitating strategies and work processes. Open data acts as an enabler of open innovation. The underlying basis for opening up of data is to increase transparency, government efficiency, and citizen engagement. The common argument that supports these strategies is *"that the publishing of government data in a reusable format can strengthen citizen engagement and yield new innovative businesses*" (Huijboom and den Broek, 2011, p. 1). This increases the necessity for the public sector to understand the value of open innovation. And so, it also increases the necessity of understanding how open innovation has been perceived in the private and public sector.

Due to the globalization private sectors increasingly understand the necessity of adapting open innovation strategies. The essence of the open innovation paradigm is not only limited to high-tech industries but extends to other industries like health care, banking, insurance, etc. (Chesbrough, 2003, p. 37-38). Open innovation in the private sector is motivated by monetary gains such as higher revenues, whereas open innovation in the public sector is pushed by service performances and public benefit (Lee et al., 2012, p. 149). Lee et al. (2012) also argues that "p]ublic sector innovation should focus more on a continuous process of interaction and negotiation among various stakeholders." Implementation of open innovation strategies in public organisations led them to a restructure of organisational forms. The old public-administration approach, "which is characterised by large-scale governmentled innovation, often national and universal in scale," (Lee et al., 2012, p. 149) is replaced by a new public management approach. This approach "attempts to restructure organization forms and processes, with heightened emphasis on user-orientation" (Lee et al., 2012, p. 150). Beside this approach, a networked governance approach is also adopted by different public sector organisations. This approach is based on "emerging patterns of governance and service delivery [where] the public is considered as a co-producer of service and innovation [and] the government can solve problems faster and accurately by harnessing a collaborative network of citizen experts" (Lee et al., 2012, p. 150). Nambisan (2008) describes two types of network governances: government-led, which can be also seen as a top-down approach and community-led, which can be also seen as bottom-up approach (Lee et al., 2012, p. 151). The essence of bottom-up approach can be realized by opening up of the data. This can actually involve citizen in governance matters and in this case government acts as an "innovation catalyst". Lee et al. (2012) further argues that the public sector is more reluctant in opening of the data. This reluctance might be due to "the responsibilities of governments to handle and protect confidential data" (Lee et al., 2012, p. 158) and also due to "*[domination]* by long service employees with strong cultural values and norms" (Lee et al., 2012, p. 158). So, proper institutionalization is necessary for obtaining the maximum value of an open innovation strategy. Such institutions will help public sector employees to recognize the potential of open innovation and realize how it can support their work practices (Lee et al., 2012, p. 159).

This understanding of open innovation theory helps us to understand the opportunity of opening up of data and how the cross sectoral open innovation can be achieved by implementing proper institutions.

Chapter 4

Methodology

In this chapter we will account for the way we approach our research from a scientific perspective and explain how we can transfer our secondary and primary empirical data into an answer to our research question. In chapter 1 and 2 we argued for the relevance of our research from a theoretical and literature perspective. We based our argumentation on written papers and contemporary research and formed the hypothesis that a normative smart city maturity model concerning open data is a means to sustain the collective value of the city on a long-term basis. Chapter 2 also discussed the terminologies that we use in our research and gave an in-depth review of the existing literature and contemporary research. The theory in chapter 3 was selected on the basis of the findings and discussions in the literature review and the information from these two chapters will function as secondary data.

The following sections will include scientific considerations pointing towards a certain way to conduct our research and work with our data in the empirical analysis, chapter 5.

4.1 Scientific Considerations

We will begin describing our research from a research philosophy perspective. This will help us understand and elaborate on our research approach and lead to valid and relevant epistemological considerations. We will use the two books "Research Methodology - A Project Guide for University Students" by Kuada (2012) and "Research Methods for Business Students" by Saunders et al. (2009) as our main methodological references.

4.1.1 Research Philosophy

The main ontological questions of matter is (1) how we perceive the reality (Kuada, 2012, p. 84), and (2) what assumptions we make about the way in which the world works. The underlying question is if we are doing subjective or objective research or a combination.

The formulation of our research questions is the main guidance for an appropriate reflection upon the research philosophy (Saunders et al., 2009, p. 109). If we recall the main research question,

How can we make a conceptual maturity model for assessing open data maturity of a smart city ecosystem, which normatively can function as a guideline for relevant actors?

then it it can be argued that this is an objective study as the primary goal is to make an assessment model, which can function as a normative guideline. Our research has an overall normative aim, where it wants to provide guidelines for decision-making and outline what a rational decision-maker shall do under some identified conditions in order to attain a given objective (Kuada, 2012, p. 42). Furthermore, the whole idea to treat a city as an ecosystem with a systems theory approach is forcing us to see social entities as systems consisting of constituent elements. And so, we accept the existence of an objectively accessible reality (Kuada, 2012, p. 86), which is our primary field of interest. These arguments lead towards an objective ontology, where we are able to generalise and presume that an objective reality exists and can be increasingly known through the accumulation of more complete information (Saunders et al., 2009, p. 110).

So far we have argued that an objective philosophy is needed for developing knowledge that can answer our main research question. But the fact that we want to model the behaviour of a smart city, which is a social system with no well-defined structure, can be an argument for adopting a non-functionalist approach to knowledge construction, where we need to understand how people (relevant actors) define situations in which they are involved and the meanings they derive from their experiences (Kuada, 2012, p. 77).

Our sub-questions are also based on social constructions such as sustainability and incentive structures:

- **Subquestion 1:** How can open data be used as a sustainability-enabler in the context of smart cities?
- **Subquestion 2:** What are the most important incentive structures for attracting support for such a model among smart city actors?

The primary goal of our research is to generalize, but only to a degree that makes sense when dealing with complex social matters. The duality of the field of our research results in a structuralist approach to social science, where we see human societies (e.g. smart cities) as composed of complex systems of interrelated parts (Kuada, 2012, p. 77). The Oxford Dictionary of Philosophy describes structuralism as

"the belief that phenomena of human life are not intelligible except through their interrelations. These relations constitute a structure, and behind local variations in the surface phenomena there are constant laws of abstract culture. (Blackburn, 2008)

A structuralist research paradigm allows us to optimize the current reality by means of a model, which encapsulates the complex social phenomena on top of it. At the same time we can work with the understanding of a smart city, and what it contains, as a social construction and use an epistemology, which combines a positivist and an interpretive approach. We take a pragmatic approach to our research, which gives us the ability to work with variations in our ontology, epistemology, and methodology (Saunders et al., 2009, p. 109).

4.1.2 Epistemological Choice

The epistemology builds on the research philosophy and concerns what constitutes acceptable knowledge in the field of research (Saunders et al., 2009, p. 112). We want to generalize in terms of a conceptual model for a social system, but in the process we want to acknowledge that we can only investigate our subject matter through the lenses of system actors and try to capture their meaning while being critical to their expressions. We have to acknowledge that what people experience are sensations, the *"images of the things in the real world, not the things directly* (Saunders et al., 2009, p. 115). Thus, a critical realist epistemology fits to our field of research.

Saunders et al. (2009) describe the critical realist approach to knowledge as follows:

"Critical realism claims that there are two steps to experiencing the world. First, there is the thing itself and the sensations it conveys. Second, there is the mental processing that goes on sometime after that sensation meets our senses. (Saunders et al., 2009, p. 115)

And so, we inherently have to capture the essence of the mental processing when developing our knowledge to be able to have an understanding of the world. In that sense, we also acknowledge that we, throughout our research, mentally process our sensations of the subject matter. This leads to a discussion of our methodological decisions.

4.1.3 Methodological Decisions

Here we want to go more into concretely describe the reasons underlying our choice of specific methods in the research process (Kuada, 2012, p. 59). It is of course based on the ontology and epistemology.

Research Approach

A discussion of our research approach might help to understand how we use our theory (chapter 3) and our literature review (chapter 2). In typical cases the research approach is obvious and straightforward to align with the subject matter and the primary research objectives (Saunders et al., 2009, p. 124). In other cases a combination of *deduction* and *induction* is needed and appropriate to fulfil a research objective (Saunders et al., 2009, p. 125) - our research arguably falls into the last category.

As previously mentioned, there is an underlying hypothesis which function as the primary driver of our research: A quadruple-helix maturity framework for cross sector open data collaboration can lead to sustainable smart city initiatives. The deduction of this hypothesis and our goal of testing it promotes a deductive research approach. We have observed some possible causal relationships between variables which we want to test and generalize.

On the other hand, our research question is based on the *assumption* that such a framework is needed, and we want to explore how it can be constructed. Our research question function as an entry into the subject matter, which can provide us with a direction for further knowledge development. We intentionally avoid imposing preconceived ideas on our research and focus on spending much time on our data analysis and let our understanding of the subject matter emerge from the data. This promotes an *inductive* research approach, where we want to build theory on the basis of the data we gather (Kuada, 2012, p. 100). We want to build theory, which can highlight how cross-sector collaboration can be catalysed by means of an action framework or as we call it: a normative maturity model. We acknowledge that our data analysis affects our understanding of the subject matter and this can lead to hypotheses that are not directly related to our research question. These can be tested in the future.

The outline of our theoretical framework in chapter 3 is not meant as a determinant and limiter of our data analysis, but rather as secondary data. It is based on the knowledge we got from the literature review (chapter 2) and is a token of preliminary knowledge development and construction. Therefore, our research approach can be considered as *abductive* (Douven, 2011) where we find the best explanations for the (evident) fact that potential value is not derived from current open data initiatives in smart cities. These explanations provides us with tools and a means to examine this potential value and get closer to a solution to harvest it.

Grounded Theory

Grounded theory as a social sciences methodology was discovered and developed by Glaser and Strauss (1967) for theory building through a combination of induction and deduction. Corbin and Strauss (1994) have elaborated on the concept and goals of grounded theory and explain its actual goal is:

"to guide researchers in producing theory that is 'conceptually dense' – that is, with many conceptual relationships. These relationships are, as in virtually all other qualitative research, presented in discursive form: They are embedded in a thick context of descriptive and conceptual writing. [This] means that grounded theory researchers are interested in patterns of action and interaction between and among various types of social units (i.e., 'actors')." (Corbin and Strauss, 1994, p. 278)

This methodology fits to our research and goes hand in hand with the systems approach to smart city conceptualisation. A grounded theory methodology allows us to use our research question as a means to develop theory, which can explain the identified issues and simultaneously function as a means to elaborate on existing theory and modify it to come closer to a solution to the issues (Corbin and Strauss, 1994, p. 273).

In our thesis we will use a grounded theory approach to understand and conceptualize the behaviour of system actors. This affects the structure of the analysis, which we will come back to in chapter 5. This is a valid way to provide a picture of the system, which is necessary for us to elaborate on system optimizations and provide suggestions to institutional changes.

Hermeneutics

Our approach to knowledge construction is, as mentioned earlier, that we throughout the research mentally process our sensations of the subject matter. Even though grounded theory emphasize a completely neutral approach to the field of research, we acknowledge that we are biased by our pre-understanding and we let that preunderstanding develop as we gather and analyse data. The structuralist paradigm and the critical realist epistemology also propose that the reality can only be understood by exploring the social relationships on top of it. A ubiquitous hermeneutic methodology, which sets the frame of the whole thesis allows us to incrementally work with our prejudice and bias of the subject matter (Malpas, 2014).

In the hermeneutic lenses we have been under the influence of a certain pre-understanding from the beginning of our research - we were biased. When investigating the subject and in the creation of our research question the old prejudice developed into a new one, which again could be elaborated on by means of a literature review and theory. This incremental process is referred to as the hermeneutic circle where knowledge construction is based on evolving pre-understandings and therefore striving for accuracy (Malpas, 2014). We will stay in this circle of development through the rest of our research and it goes hand in hand with the grounded theory approach.

4.1.4 Qualitative Research Interview as Empirical Data Gathering

As indicated throughout this section, we have to do qualitative research to be able to capture the essence of our subject matter. We will go a bit more into the nature of qualitative research and use Kvale (2007) to explain how we can use qualitative research interviews to enable us to understand how an answer to our research question can look like.

Kvale (2007) deals with a specific type of interview style called a *semi-structured interview*, which is neither an open everyday conversation nor a closed questionnaire. It seeks to "obtain descriptions of the interviewees' lived world with respect to interpretation of the meaning of the described phenomena" (Kvale, 2007, p. 11). Proper planning the semi-structured interview is important. The first thing to do is thematizing, which consists of "formulating the purpose of an investigation and the conception of the theme to be investigated before the interview starts" (Kvale, 2007, p. 35). We have done that prior to all our interviews and the result of the thematizing can be found in the interview guides (Appendix B), which is the product of designing the interview (Kvale, 2007, p. 36). We have transcribed all the interviews and the transcriptions can be found in Appendix A.

In our case the semi-structured interviews are both *explanatory*, because there is an underlying aim of testing a hypothesis, and *exploratory* in that we introduce an issue, an area to be charted, or a problem complex to be uncovered (Kvale, 2007, p. 38). We have aimed for more descriptive interviews, which can support the grounded theory approach and contribute to the development of new grounded theory.

All our interview are, due to the nature of our research, mostly conceptual. We want to "chart the conceptual structure of a subject's conceptions of phenomena" (Kvale, 2007, p. 71) and narratives such as 'smart city', 'sustainability', and 'open data'. We of course frame the interview to be centred around our research question.

During the analysis we will assess the validity and reliability of all the interviews (Kvale, 2007, p. 122). We will strive for being critical to the interpretation of the meanings of the interviewees. At the same time we have to use meaning condensation to be able to structure the analyses of the empirical data in a way that clarifies our research progress (Kvale, 2007, p. 108).

4.2 Presentation of Interviewees

We have tried to contact several people and we managed to set up interviews with seven people from different sectors and with diverse interests. Common to them all is their full time interest in smart cities and the use of ICT to sustain or even increase our quality of life. A full list of whom we contacted can be found in appendix C.

4.2.1 Kristoffer Hvidsteen

Kristoffer Hvidsteen is working as Sustainbility Lead in Denmark for Accenture and helping the organisation to act in the sustainability phase. Accenture is a global consultancy company with more than 100.000 employees operating in the whole world. They provide assistance and advise regarding strategy, outsourcing, and technology development for other companies and clients (Appendix A.1, 03:15). The following quote is taken from their website and shown how Accenture understands the concept of sustainability:

"Accenture is committed to helping forward-thinking organizations position sustainability as a key lever to long-term success and, ultimately, high performance. We help organizations leverage their assets and capabilities to drive innovation and profitable growth while striving for a positive economic, environmental and social impact."¹¹

Additionally, Accenture participates in the smart city and open data discussions and technology developments.

We find an interview with Kristoffer Hvidsteen relevant because he represents a big and important player from the private sector.

4.2.2 Søren Møller Jensen

At the time we contacted Søren Møller Jensen he was hired as project consultant in Copenhagen Capacity (Appendix A.3, 48:51), which is a publicly funded consortium promoting business and foreign investments in the city of Copenhagen. He is now hired as Business Development Manager in Copenhagen Capacity where he specifically works with smart cities from a business and innovation perspective. He tries to uncover the business potentials of the smart city through dialogue with companies, knowledge institutions and public authorities (triple-helix).

We met Søren Møller Jensen in May 2014 at the conference ICN Summit 2014^{12} in Copenhagen, and so he was an early part of our research process. He has recently

¹¹http://www.accenture.com/us-en/Pages/service-sustainability-intelligent-citiesstrategy.aspx

¹²https://www.etouches.com/ehome/icnsummit2014/welcome/

published the report called *Smart City* - a position of strength in the capital region¹³ (Jensen, 2014), which has also played a role in shaping our research and sharpen our smart city interest.

Taken from Copenhagen Capacity's website:

"Copenhagen Capacity is the Danish capital city region's official organisation for investment promotion, business development and cluster growth. Founded as a non-profit organisation with the mission to grow business capacity in the Copenhagen region, Copenhagen Capacity works to:

- strengthen the region's international competitiveness.
- market its strongholds internationally.
- improve framework and factor conditions for businesses, cluster organisations and international talent."¹⁴

Søren Møller Jensen is relevant to us because of his cross sector research and experience with how smart cities can attract business while still keeping a holistic view on the sustainability of the collective welfare.

4.2.3 Henrik Korsgaard

Henrik Korsgaard is PhD student at Aarhus University and has a background in Information Studies with a focus in Interaction Design. And so, he sees himself as researching on the border between engineering, business, and urban planning. He is not solely researching on the concept of smart cities but is focusing on a micro view on the city to understand how to prototype and work in an urban context when doing technology development (Appendix A.4, 03:30). Together with Martin Brynskov he has written the paper "Prototyping a Smart City" (Korsgaard and Brynskov, 2012) where they

"argue that by approaching the so-called Smart City as a design challenge, and an interaction design perspective, it is possible to both uncover existing challenges in the interplay between people, technology and society, as well as prototype possible futures." (Korsgaard and Brynskov, 2012, p. 1)

We find Henrik Korsgaard interesting and relevant to our research because he represents academia and a research institution that is deeply concerned with smart cities¹⁵. Secondly, his research perspectives are interesting for us because one can find similarities between his design-approach and our expected normative outcome.

4.2.4 Søren Kvist

Søren Kvist is Senior Enterprise Architect in the Department of Technical and Environmental Management in the Municipality of Copenhagen¹⁶. His initial job was to see if the municipality could use a new city-wide street light infrastructure for anything else than just providing light. This emerged into the smart city project called

¹³Translated from Danish: Smart City - en styrkeposition i hovedstadsregionen

¹⁴http://www.copcap.com/About%20us

¹⁵http://smartcities.au.dk/da/

¹⁶http://dk.linkedin.com/pub/s\T1\oren-kvist/1/521/37b

Copenhagen Connecting which has recently won a prestigious smart city price at the 2014 Smart City Summit in Tel Aviv (which we also mentioned in section 1.4). The project is driven by Copenhagen Solutions Lab which Søren Kvist is part of. Project plans and indicators of social and economic impacts has been developed but it has not been realized yet (even though the buildings are ready for actors to move in and collaborate). The project is mainly focused on making data-driven solutions based on sensor data placed in sewers, trash cans, street lights, etc. throughout the city, and provide it to entrepreneurs and companies and by that let the market drive the solutions and make the project self-sustainable (Appendix A.5, 05:13). The project is meant to be a means to reach the 2025 carbon-neutrality goals of the Municipality of Copenhagen. The data-driven solutions will consist of Intelligent Transportations Systems (ITS), and generally services for using the existing resources in the city a lot more efficiently (A.5, 07:00).

Søren Kvist is very relevant to our research because he is the initiator to a concrete data-driven smart city project based on open data. The fact that he is hired as Enterprise Architect is also appealing to us because we base our research on ideas and concepts from the field of Enterprise Architecture (mainly maturity and the systems approach).

4.2.5Ville Meloni

We will point to the presentation of Ville Meloni from the website of Forum Virium Helsinki, which is a non-profit cluster organisation that serves the whole quadruple helix by "develop/ing] new digital services in cooperation with companies, the City of Helsinki, other public sector organizations, and Helsinki residents. The aim is to create better services and new business, plus to open up contacts for international markets. Forum Virium Helsinki is a part of the City of Helsinki Group."¹⁷ They write the following about Ville Meloni:

"Ville Meloni has worked with Forum Virium Helsinki since November 2009. Currently he works in the 6Aika Strategy Office as Programme Manager.

6Aika strategy is part of the Finnish EU Cohesion policy 2014 - 2020 sustainable urban development theme. In 6AIKA six major cities of Finland co-operate in developing better services for their citizens and opportunities of new business and growth for their companies. City dwellers' lives improve, when important everyday services are available also as digital alternatives in addition to traditional ways.

Previously, Ville has managed the Helsinki Region Infoshare project, which aims to make the City's public regional data easily available for the residents, communities and anyone else with an interest in it. Ville is responsible for the execution of the project together with the City of Helsinki Urban Facts and other communities involved."¹⁸

Ville Meloni is relevant to our research because of his deep experience with and knowledge about how to use open data to enable the creation of sustainable crosssector smart city solutions that serve the whole quadruple helix.

¹⁷http://www.forumvirium.fi/en/introduction/mission-and-vision-values

¹⁸http://www.forumvirium.fi/en/contact/ville-meloni

4.2.6 Adrian Ulisse

Adrian Ulisse is CEO & Founder of Ethos Smart Cities and Communities, which is a smart city forum/project under the wings of the Ethos consortium. The ambition of Ethos, over the next 5 years, is to help 1 million people align their work to their passions for the benefit of all¹⁹. And so, sustainability is the main driver of this consortium, and institutional changes are of no hindrance to the visions of Ethos:

"We believe in putting the problem at the centre instead, and giving its ownership to the people that will attempt to solve it. And by finding capable people that really care about the problem, we find their passion alone can motivate them to work together to solve it, instead of having to rely on money as the main stimulus."

They emphasize how collaboration cannot happen without trust and the creation of that trust is exactly what drives this thesis.

The Ethos Smart project is about driving these visions out in cities by means of open data, which can be beneficial to citizens, business, and the city itself. A holistic approach is a key strategy and Ethos Smart provides sustainable solutions to the global challenges facing cities that will make a positive impact to their citizens lives, protect the environment and encourage prosperity for all²⁰.

Adrian Ulisse has 25 years of experience in the ICT industry and has worked for large systems integrators mainly dealing with civil infrastructure, airport supports, and oil and gas infrastructures – all about deploying systems to make an infrastructure better. As cities are an aggregations of a range of different infrastructures, which are clearly not very well integrated today, he has a strong interest in the city perspective (Appendix A.2, 02:05). When working with an intelligent city project in Malaysia, he realised that systems integration on a city level is not a technology issue but rather a people and organisational issue. 18 months ago he decided to set up a smart city business for making holistic solutions, which was made possible with the help of Ethos from where he got a number of interesting projects and associated funding (A.2, 03:20).

The relevance of an interview with Adrian Ulisse is evident as he shares some of our ideas and his project is a real, tangible project that see sustainability as a key driver for holistic smart city solutions by means of open data.

4.2.7 Lasse Steenbock Vestergaard

Lasse Steenbock Vestergaard is working in the Smart City Lab at the Alexandra Institute in Aarhus. The Alexandra Institute is a private non-profit organisation, working with applied research, development and innovation in IT with the aim of creating growth and welfare in Danish society²¹. They arrange the annual event Aarhus Data Drinks which tries to assemble relevant people around open data and facilitate discussions to foster mutual understandings in an informal environment²².

¹⁹http://ethosvo.org/about/vision/

²⁰http://www.ethossmart.com/

²¹http://www.alexandra.dk/dk/sider/default.aspx

²²http://www.alexandra.dk/dk/aktuelt/arrangementer/arrangementer-2014/okt-dec/sider/aarhus-data-drinks_9_ivaerksaetteri.aspx
They are also involved in smart city projects where they see open data as one of the main catalysts of collaboration and value-creating partnerships²³.

Lasse is relevant to us because he has knowledge about the technical and managerial areas and issues when implementing concrete open data platforms and solutions in a smart city $context^{24}$.

²³http://www.alexandra.dk/uk/right_now/news/news-2014/jan-mar/pages/three-reasonsfor-using-open-data-to-make-the-city-smart.aspx

²⁴http://www.alexandra.dk/dk/medarbejdere/sider/lasse-steenbock-vestergaard.aspx

Chapter 5

Analysis

The purpose of this analysis is to systematically go through the presented secondary data and use it to extract the information from our primary data that can lead to an answer to our research question. The secondary data can help us to find value in our interviews and help us to structure the initial information chaos.

We will initiate our analysis with an outline of our current standpoint in section 5.1. We will give a summary of how we understand our subject matter so far. This will provide the reader an understanding of the basis of our analysis and recapitulate the most important thoughts of our research till now. Our grounded theory approach requires us to communicate clearly about our findings and how we constantly develop new knowledge.

In section 5.2 we will give a small evaluation of the interviews. It is important to elaborate on the validity of the interviewees and evaluate to which extent we used the interview guide.

The findings of our analysis will be presented in section 5.3. The structure of this section will follow a certain path of a meaning condensation based on the secondary and primary data.

The product of this analysis will be presented in section 5.4. According to our research question we strive to come up with a conceptual normative model for establishing collective open data maturity in a smart city which we have considered necessary for sustainable open data initiatives to evolve. Here it will be revealed to which extend we are able to answer our research question. We will provide elaborations on our findings and widen up to a broader discussion in chapter 6. Here we allow ourselves to induce new theory if possible and discuss where our grounded theory approach has led us.

The last part of our analysis will be a short elaboration on the outcome of this whole chapter; how the conceptual model incorporates the ideas of the primary and secondary data and corresponds to our research question. In chapter 6 we will go more into a discussion of how further research can enhance its validity and usability.

Using grounded theory in our analysis

We have put a great emphasis on our use of grounded theory so far. In the methodology, subsection 4.1.3, we have outlined basic grounded theory literature by Corbin and Strauss (1994) saying that grounded theory researchers are interested in patterns of action between and among various types of social units. Our primary data holds information about these patterns of action among various types of social units and a great portion of value is to be unveiled from these interviews partly by means of our secondary data. The article "Guiding the Use of Grounded Theory in Doctoral Studies" by Jones and Alony (2011) explains more concretely how to extract this value obtained using grounded theory. They write that "grounded theory offers many benefits to research in Information Systems as it is suitable for the investigation of complex multifaceted phenomena. It is also well equipped to explore socially related issues" (Jones and Alony, 2011, p. 95).

Jones and Alony (2011) explain the differences between *Glaserian* and *Straussian* grounded theory. We have presented the ideas of Anselm Strauss before and in this article, the Straussian grounded theory approach is condensed down to these points (an extract) (Jones and Alony, 2011, p. 99)

- Having a general idea of where to begin.
- Forcing the theory, with structured questions.
- Conceptual description (description of situations).
- The theory is interpreted by an observer.
- The credibility of the theory comes from the rigour of the method.
- Basic social processes need not be identified.
- The researcher is active.
- Data is structured to reveal the theory.

We follow these points quite accurately. In this chapter we focus on the last item of the Straussian grounded theory. One can say that in section 5.3 we do selective coding where core categories become apparent.

"A core category is a category that has developed through densification and that explains most of the variation which represents the participants' major concern. It should relate meaningfully and easily to other categories." (Jones and Alony, 2011, p. 107)

In section 5.4 we condense the selective coding and do *theoretical coding*. We argue that our seven interviews constitute a richly saturated research field and that allows us to draw conclusions from the data collection and the selective coding (Jones and Alony, 2011, p. 107):

"Theoretical coding knits the fractures pieces back together again to conceptualize causal relationships between the hypotheses derived through open and selective coding. [...]. The final result is a model depicting the basic social process [that] reflect and summarize the patterns of behavior which are fundamental to the phenomena." (Jones and Alony, 2011, p. 108-109)

5.1 Preliminary grounded findings

In this section we will describe our current stance and explain our preliminary understanding of the subject matter. During the investigation of the subject matter our understanding kept changing and our bias has developed.

Our research started with understanding the nature and characteristics of smart cities and identifying open data as a fundamental smart city enabler. Based on the relevance of open data in smart city context, we developed two presumptions (subsection 1.1.2). Our research is based on these two presumptions that indicates the relevance of investigating the areas of smart cities and open data. Looking into these areas for understanding their constructions and development and understanding their relationship regarding different phenomenons (sustainability and open innovation) will help us to realize the possibility of setting up a desired sustainable smart city. We also realized that a healthy ecosystem (ecosystem with relevant actors) probably can manage and exploit open data to deliver to its full potential and develop successful open data initiatives, which enables a city to be smarter. Moreover, we found that building a healthy ecosystem that understands the potential of open data and the essentials of unleashing this potential requires a certain level of collective mindset among the relevant actors. This assisted us in formulation of our research question, which is as follows:

How can we make a conceptual maturity model for assessing open data maturity of a smart city ecosystem, which normatively can function as a guideline for relevant actors?

Following a grounded theory methodology we use our research question as a means for developing a theory. To be able to answer the research question we obviously needed a good understanding of the concept of smart cities: how can a city be advanced into a smart city? who are the possible actors? what are different entities defining a smart city? what characteristic does a smart city posses? etc. To investigate this we explored the existing literature. Keeping our presumptions (subsection1.1.2) and our research question in mind, we explored four relevant areas: Smart cities, sustainability, data, and maturity. This exploration of existing literature sharpened our knowledge about the subject matter and formed a basis for our choice of relevant theories.

By understanding smart cites from different aspects, we came to realize that smart cities are not only related to technological advancement but also to the advancement of society and people (subsection 2.1.1). We also became acquainted with six basic characteristics of smart cities (smart economy, smart people, smart governance, smart mobility, smart environment, and smart living). Based on these characteristics smart city initiatives are developed and these initiatives form the fundamentals for the success of smart city development. Moreover, development of successful smart city initiatives require proactive engagement of the triple-helix (subsection 2.1.2). This led us to necessity of understanding the smart city ecosystem and the actors involved.

We also realized that looking at smart city as a complex ecosystem helps to understand the complex relationships between different systems and components within it. Furthermore, it also help us to identify different relevant actors. This leads us to another discussion about the related actors. In chapter 2, we identified the related actors and their influence in smart city development. Throughout our secondary data gathering, we also came to realize citizens as one of the influential actors in smart city development, who actually can be seen as a facilitator for smart city development (subsection 1.1.1).

We also identified that unaligned or conflicting interests of relevant actors hindered a holistic approach for smart city development. Sustainable development in smart cities requires the actors to develop their mindset in the same pace. This requires the actors to break down their business silos. An enabler of this is crosssectoral opening of data.

Open data initiatives can be seen as subsystems within the smart city (section 3.1). We have found that open data is as a resource for new economic development, enabler for open innovation, and a core enabler for sustainable development in smart cities (subsections 2.3.3 and 2.2.3). Furthermore, we have shown that the cross sectoral sharing of data can provide new paths for business development and open innovation (subsection 2.3.5).

The combination of different types of data from different sectors actually has the potential to create an extra value within society. Despite of this great potential, reluctance in the opening of data from different sectors has been recognized – especially in the public sector. The main reason for such a reluctance is due to the distrust among different sectors (subsection 2.3.5). We have also identified that the actors involved in cross-sectoral open data development do not have the same level of mindset in regards to how to to capture optimal value from such a collaboration. This is also because of the lack of willingness to think holistically.

We analysed existing smart cty maturity models that are relevant to our research. All the models we analysed focus on different areas such as enterprise architecture, smart cities in general, and open data. The EA maturity models are mainly focused on holistic approaches to organisational development. The smart city maturity models are mainly focused on creating successful smart city initiatives and providing an overall maturity of the data-driven smart city (subsection 2.4.4). The maturity models related to open data are either focused on specific types of data, like Open Government Data or are only available for specific clients. Furthermore, none of the maturity models we have discussed form an action model actually showing how to move from one stage of maturity to another in a smart city context (subsection 2.4.2).

We have identified a smart city as a complex ecosystem where open data initiatives are subsystems that consists of different actors such as public, private, knowledge institutions, and citizens. All of these actors are somehow influenced by their own interests, which acts as a hurdle in the development of a well-defined open data subsystem. So by identifying these hurdles and developing incentive structures for different actors, we argue that one can encourage sustainable cross-sectoral open data initiatives. It is important to embrace open data from a more holistic perspective, which requires all the actors to be in the same level of mindset maturity. So, the next step in the process is to identify different the factors that influence the maturity of a collective open data mindset.

5.2 Validity of the Interviews

Many of the persons that we interviewed (Søren Møller Jensen, Ville Meloni, Henrik Korsgaard, and Lasse Steenbock Vestergaard) either work for research institutions or non-profit organisations and therefore we estimate a high validity of their statements due to apparently unbiased interests. Their primary driver is to communicate and widen their knowledge about their field of research. None of these interviewees were concerned about how we quoted them and demanded to validate any quotations.

Adrian Ulisse is working for a private organisation/consortium but the core of his work is based on holistic thinking and cross-sector research and we also estimate his statement to have a high degree of validity. We should be a little more careful with Kristoffer Hvidsteen because he represents a big player in the private sector and can therefore be biased towards his own interests. The same goes for Søren Kvist who is deeply involved in a concrete smart city project which is funded by the municipality of Copenhagen and he inherently serves the interests of the public sector (at least in the current stage of Copenhagen Connecting). Therefore he is also more biased than then four before mentioned interviewees.

All in all we do not think that any of the interviewees have interests in hiding crucial information to our research.

During all the interviews we used to interview guide (Appendix B) as a reference point for the discussion. But as one can see from the transcriptions, we asked many additional questions that we found relevant and we made full use of the semi-structured interview.

All the interviews were done using Skype except the interview with Søren Kvist which was a face-to-face interview in the new buildings of Copenhagen Solutions Lab.

5.3 Findings

Previously we mentioned that in this section we condense meanings from the thoughts, statements, and opinions of the primary data. We juxtapose this meaning condensation with what Jones and Alony (2011) refer to as selective coding where core categories are catalysed and become apparent. The section is structured on the basis of the coding. Throughout the section we will elaborate on the data by means of our current knowledge, i.e our secondary data, and our research question.

The following three topics are the results of this coding:

- Business silos breakdown the necessity for a holistic approach.
- Top-down versus bottom-up approaches.
- Maturity the importance of a collective open data mindset.

5.3.1 Business silos breakdown – the necessity for a holistic approach

In the literature review, primarily section 2.4, we referred to existing maturity models depicting various kinds and scopes of maturity. Most of them emphasized the importance of a holistic mindset when tackling cross-department/unit problems.

Ross et al. (2006), figure 1.3, address maturity from an Enterprise Architecture perspective and identify the ability to be agile, flexible, and responsive to shifting requirements as the optimum. An organisation has to reach the optimised stage by following an evolutionary path where their business silo mindset is stepwise broken down and the organisation incrementally evolves its collective maturity to take cross-silo decisions, which have to be supported by a cross-silo IT architecture.

IDC Government Insights' smart city maturity model (Clarke, 2013a) is very similar to the above mentioned model even though it is addressed to cities instead of companies. One can see this as an attempt to treat the city as an organisation to comprehend the inherent complexities. They too have identified a final stage which has sustainable characteristics – the city is agile and understands how to continuously improve and align the areas of strategy, IT, and governance in a de-siloed manner. Cross-department thinking, mindset, and willingness is crucial for the smart city to sustain in following the pace of development in the long run. The de-siloed city is willing to take the risks of holistic, long-term thinking because they carry greater weight than the risks of not doing so.

The Open Government maturity model by Gartner (figure 2.12) depicts how a city can benefit from being open and strive for collaboration and engagement in maturity levels 4 and 5. They present Open Government as an inevitable asset to successful and sustainable smart city initiatives where overall strategies are enterprisewide and engaging all relevant actors. This is similar to fostering a collective mindset across the city, across the various actors. The underlying point is that a holistic approach is needed to establish a sustainable smart city ecosystem. The public sector also has to break down their business silos and look for cross-department synergies for the projects to become a reality and sustainable.

All in all it seems like an overall vision is to minimize the risks of a deep lock-in to these business silos, which prevents the city to harvest the value of horizontal integrations within the cities. But there are still many unanswered questions for us to be able to make a conceptual model for institutional design that contributes to a business silo breakdown. Who are the relevant actors, besides the overall public sector, that have to break down their silos? How can you do such a breakdown from a city perspective and is it altogether possible? How to make these actors willing to participate in such a process? We will now search for answers to these questions in our primary data, the interviews in Appendix A.

The nature of silo-thinking in a smart city context

Adrian Ulisse is describing how the unwillingness to share information is an obstacle to the required collaboration for aligning mindsets: "I did my first project in smart cities, at the time called intelligent cities. It was a project out in Malaysia where they were building a new city for a half million people. That was very interesting because I learned that it wasn't a technology issue, it was actually a more people and organizational issue. We visited every single government department in the city and found that lots of the individuals wanted to share or conceive data but were less comfortable about sharing their own data, which was an interesting observation." (Appendix A.2, 02.55)

The necessity for institutional redesign was identified before the introduction of smart cities. We can address this as an institutional issue because the interactions between parties are *not* contributing to the functioning of a technological system. There are no established rules of the game that ensure a win-win situation yet.

Ville Meloni adds to that and describes how the future business environment requires new ways to collaborate to become agile and respond to external challenges. This requires an insight to other business domains and therefore an understanding of the necessity for opening up your own domain:

"the logic is that in a closed system, whether it's closed data or closed source which is not sharing information, the idea is that it's very inefficient. In the future there are a lot of challenges, there is less money, things change more quickly, there is digitalisation. So, you need to be more agile and we believe that one of the ways for that to happen is to open up your processes, open up your data and collaborate and work together. And that enables hopefully cost savings, better services and that also hopefully enables reacting quicker both citizen and company needs instead of being very closed and not cooperating." (Appendix A.7, 32.02)

It is not sufficient to enclose oneself in a comfortable silo with no apparent uncertainties. Open data can contribute to give birth to this new collaboration.

Søren Møller Jensen outlines the triple-helix ecosystem that has to be institutionalised for open data solutions to become successful:

"First of all [we have] the public authorities. They own some of those resources, they control how the resources are handled and how the infrastructures build up. And you of course have the companies who are the ones most well suited to come up with commercially feasible solutions and the most cost effective solutions. And finally the knowledge institutions of course they [are] a very important independent partner. They can be the ones trying to create a link between public authorities and companies because very often we hear companies complaining that the municipalities don't get the ideas of what the companies technologies are able to do." (Appendix A.3, 25.39)

And so, these three triple-helix actors have to have an in-depth understanding of each others domain and do cross-sectoral thinking. Adrian Ulisse is depicting that the main governance structure is not capable of thinking holistically because of its embedded opposing institutional design. And so, it requires some incentives and eye-openers for the public sector to look outside their own subsystem:

"The very nature of the central governments is broken into silos – from ministry of transport to ministry of energy etc." (Appendix A.2, 17:00)

It is a matter of facilitating a collaboration between these city actors which requires them to understand and treasure mutual benefits and synergies. There is a false security in sticking to the secure and familiar environment of ones own business silo. Kristoffer Hvidsteen gives an example of this:

"If you don't think about aspects beyond the single bottom-line you are at great risk, and in some industries really great risk, of overlooking important aspects of your role as a company, your role as an organization, which will limit your ability to create value for your clients, especially in the medium and longer term matters, to be able to function properly and effectively. So in that sense it's an emerging scope for many companies and organizations to start thinking about this in a holistic and a systematic manner." (Appendix A.1, 04:35)

So you have to think holistically to ensure a long-term sustainability of any company or organisation. Henrik Korsgaard also gives an example:

"The main obstacle is that everybody working in this space is employed or working from a particular perspective. So if you are working in a municipality, you either work with sewage, traffic, or child day care, so you have a very narrow perspective. You see one slice of the holistic pie, so to speak. The same goes for industry. You have a market, where you don't sell holistic solutions. You sell solutions for a specific market, right?" (Appendix A.4, 13:10)

The problem is, according to Henrik Korsgaard, that the normal *siloed* value chain breaks down and becomes much more distributed along a very complex network of stakeholders (Appendix A.4, 16.00), which can catalyse deal breaking uncertainties to the relevant and necessary actors. Søren Kvist is concurrently saying that "the city is very much focused on what their responsibilities are at their department." You have to look between these silos to reap the value of the synergies lying in between them (Appendix A.5, 10.00) but "today there is really no formal institutions are supposed to make this increased collaboration work between sectors when it comes to smart city." (Appendix A.5, 12:20)

New institutions have to be formed for the open data silo breakdown to work, institutions that normalize the act of holistic thinking when doing cross-sector collaboration:

"When these organisations are used to work in silos, it's in their like organizational culture to focus on one thing from their perspective and then this data opens the eyes and [they think]: 'OK. Wow. I can look at this from 5 or 10 different perspectives.' I think many understands that it makes sense because if you take this things better into account it's more sustainable. You do less of the same or you keep inventing a wheel. But it also means that you need to collaborate and then take a lot more things in to account. It's very painstaking at first because you need to agree on how to do this." (Appendix A.7, 23:10)

The organisations might accept that somewhere inside their data, potential value is hidden. And that value might only indirectly come back to themselves if they make them open. So new institutional design has to consider how to make this value more tangible. This is a way to realize a sustainable collaboration environment based on open data.

Open data is a means to enable integration across business silos which is vital for harvesting the mentioned synergies. Søren Møller Jensen emphasizes how holistic thinking is the only way to achieve sustainable solutions where the smart city actors can benefit from the data and information of each other: "Sustainability comes from better integration across the various different silos in different cities. Transportation and energy is very much interlinked but very much run separately in terms of how they operate it. Not one element works optimally in isolation. [...] I think another thing you see happen across the world is trend of sharing business models. When you walk around in a city you start to realize that we are buried in inefficient use of our resources." (Appendix A.2, 11:10)

Søren Kvist agrees with that and says that "if we use data in a more targeted way than we have done so far, we can use it to use the resources within the city more efficiently" (Appendix A.5, 06:45). Ville Meloni has the same point and explains how open data has a two-sided effect. If treated correctly data sharing can catalyse collaboration and engage in a cross-sectoral learning process. At the same time it is a catalyst to opening up more data and utilise it horizontally with the overall goal to exploit common and privately held resources more efficiently:

"I think there are lot of things that you can do with data, lot of understanding, you can optimize things better, you could sort of share more, you could collaborate more and you could sort of, I guess its also a way of learning." (Appendix A.7, 06:01)

This understanding of each other's domain is one of the pillars in smart cities, which enforces a holistic mindset where the actors ideally should be so mature that they understand that sustainable long-term goals can be met by increasing the total value of the smart city system and its subsystems. Henrik Korsgaard elaborates on this:

"Understanding the needs of the other and understanding that what is valuable for me, that is both for private and business levels, is not valuable for you. That is what is changing with the smart city." (Appendix A.4, 14:30)

But still there is a long way to reach this inherent mutual understanding of each other's domain. The public sector is often the initiator of data-driven smart city initiatives, but they are not sustainable because they need data from other departments or the private sector to really yield some value - cross-sectoral open data mindsets are simply vital for its success. Adrian Ulisse explains this situation:

"you have central government officials trying to react to something rather than actually properly plan. One of the big issues, and it's a wider issue than just for smart cities, is there is a level of distrust between the private and public sector. [...] The understanding of what problem you are trying to solve is not being thought through. So as they may publish one data element you can't solve the problem without other elements of data and that might be from the private sector, it might as well be from citizens." (Appendix A.2, 23:20)

Cross-silo-thinking is an important means to the creation of the smart city as a whole where data has to be allowed to flow across sector boundaries enabling sustainable smart initiatives to emerge. Open data is not a goal in itself but a means to achieve a range of goals within the smart city.

"[Cross-silo-thinking] is a very important manner as for the ability to see new connections, how your professional sector might relate to the other competencies. Also it's a matter of mindset because you need to pro-actively challenge your own competences and the area you are working within and how that might will be able to relate that to other areas. You cannot just do that just re-actively because very often if you only being re-active you will never see the possible new relation, you are very likely to get stuck within your own area." (Appendix A.3, 14:00)

Of course it requires some open data maturity for a smart city actor to understand how to make the benefits of challenging its own working area weight higher than the (false) security of concerning itself with its own familiar business silo. He goes on and explains how Copenhagen Connecting is

"trying to focus this mindset. And you can say that the willingness to actively challenge whatever existing solutions you have that could be one of the indicators you have." (Appendix A.3, 37:55)

What Søren Møller Jensen is saying here goes along with the smart city wheel by Boyd-Cohen (figure 2.10) who argues that a smart city has to have some indicators to measure the progress of the city. This willingness to pro-actively challenge your existing solutions, working areas, and competencies is linked to the agility of the actor to adopt to external developments and new requirements. An agility that can only be reached if a horizontally integrated mindset is developed so sustainable cross-silo solutions can be fostered. Søren Kvist also elaborates on the necessity of breaking down business silos:

"The challenge is that you need an increased collaboration between different business units if you want to make better solutions. Because otherwise you will just do silo solutions, meaning that you will roll out one solution for specific business units throughout the whole city and that's not necessarily the best way to do it. It's not that it's not going to work technically but it's not necessarily the best technical solution and you wont really harvest the synergies between thinking cross-horizontally." (Appendix A.5, 13:30)

In the introduction, section 1.4, we mentioned the Big Data Infrastructure tender managed by the cluster CLEAN formerly known as Copenhagen Cleantech Cluster. Unfortunately we were not able to get an interview with any of the responsible people of this tender inside CLEAN, but it is still interesting for us because it is meant to be a way to actually catalyse the kind of collaboration and mutual understanding that we have addressed so far. Søren Møller Jensen is mentioning it:

"Who ever wins going to have a task of running that infrastructure but whatever happens on top of that they are not supposed to restrain and I don't see how they could restrain that. [...] basically it supposed to be infrastructure, which can subsequently be accessed, by lots of other companies and public authorities and whomever." (Appendix A.3, 32:00)

As we do not have any primary data or in-depth secondary data about this Big Data Infrastructure we can only assume what its potential purposes are. We do not know the detail levels of the project plans and to which extend the obligations for the winner are formulated. We do not even know anything about its specific substance. But the idea of having a platform run by a keystone actor with obligations set by a knowledge institution is not irrelevant to our research.

Obstacles towards business silo breakdown

Great uncertainties emerge when silos disintegrate and there is some evident reluctance towards holistic thinking:

"Every time you make a new system and change the existing systems you need to take into account the consequences of this. Just as the value chain is breaking down and becoming more distributed, so is the causal relationships in the city. So, every time you build a new system where you take some data in, you might marginalise and hurt somebody." (Appendix A.4, 27:30)

For open data to become a part of the smart city, you have to anticipate rebound effects and unintended effects in the long run. One way to do that is to start with a small well-defined subsystem as a solution to a specific city issue. In such a subsystem an ecosystem can be built with understandable value propositions that every actor should benefit from in the end. This will make the open data solution sustainable by designing an institution based on some form of mutual agreement and aligned mindsets.

Lasse S. Vestergaard points at another obstacle for business silo breakdown, which is not compatible with the required agility:

"if we can begin to look at data that we have never looked at before and when we try to merge that we will be able to have new knowledge and even within the municipalities, not only municipalities, within the public sector they are already today aware of that if they could aggregate two specific data sets, they would be able to get completely new insights. But they can't because of legislation. (Appendix A.6, 18:41)

We do not have the expertise to elaborate on the inherent legal issues in the aggregation of data, but it is just to mention that there is a framing legal institution confining the subsystem of matter. This legal institution is more difficult for us to handle.

The quality of the data is also a very big obstacle for using it as a means to enhance collaboration and silo breakdown. Lasse S. Vestergaard says that

"if the quality of the data is not good enough you cannot create anything but if you don't understand the data it's really hard too because you need to work from both sides: You need to have a better quality of data but you also need to get a better mindset for a better understanding of what you can do with the data." (Appendix A.6, 43:00)

Two things are required for open data to be beneficial for other smart city initiatives: (1) You have to have data of a certain quality - that might follow the guidelines by Tauberer (2014) (figure 2.13) so the right data type and exposure mechanism is chosen from the beginning - and (2) you accordingly have to develop a mindset that understands the data and the exposure mechanisms. These two conditions are causal for silo breakdown to happen by means of open data.

These conditions leads to interoperable data and Ville Meloni explains how the ecosystem should use the expert companies to foster the interoperability:

"So, I think the interoperability of the data and the data quality [is important] and I think there is a big role for IT companies and other companies to actually take the data and help the government and other data owners to make it more interoperable." (Appendix A.7, 18:04)

Incentivisation towards business silos breakdown

We will now go through the statements that point actions that can be taken to break down business silos. Adrian Ulisse is describing how funding is vital as incentive for financial leaders to encourage more integrative thinking and break down business silos:

"I think you have to use the financial leaders to encourage more integrative thinking, and that might be moving funding or making funding dependent on action." (Appendix A.2, 19:22)

It is important to establish some direct economic incentives for the actors to be willing to participate but incentives can also be more indirectly economic. Søren Møller Jensen explains how the actors can develop an understanding of how to harvest value from getting access to foreign data and share their own data:

"... you need to consider what might incentives be for me to open up the access to that data for another company. Imagine another company, for example within finance or insurance, get access to a wider pool of data. Then they might be able to offer me some sort of service – not necessarily a physical product, but it could be some sort of other service." (Appendix A.3, 08:18)

He goes on and says that it is a very difficult task of formulate value creation which is not abstract and not related to the overall system level:

"... it is much easier to describe or formulate how that value can be extracted on the society level. I mean you can also formulate how it can create value in the individual level but the thing is if this is going to happen, you would need some sort of ability or desire to pay at individual level otherwise you would have say if you have all of those solutions be legalized through taxes." (Appendix A.3, 06:08)

This implies that the initial success of an open data initiative should focus on value proposition that result in short term wins directly for the actors. This will function as an understandable incentive to participate. Henrik Korsgaard explains that even though you have the initial funding for setting up an infrastructure for collecting valuable data on a city level, it does not provide sustainable value if incentives structure for sharing that data are not established:

"You have to give, for instance, a guy in the traffic department a certain budget to fix the street, to set up sensors that can harvest data and so forth. But you wont be able to link what he does to what a business does." (Appendix A.4, 17:30)

Søren Kvist continues this argumentation and says that

"if we can reuse the building blocks between different business domains [...] then we can provide better solutions and we can provide new insight in regards to making solutions better." (Appendix A.5, 15:16) He gives a more concrete example of a business model expansion using open data in the insurance domain. It requires a special kind of collaboration and mutual understanding to reach a stage where such initiatives can be realized. Yet Copenhagen Solutions Lab has not looked into this:

"of course there is a high incentive for insurance companies to make these solutions a success, because that will mean that the damages caused by cloud bursts will be a lot lower because we will know where there are humidity problems, and one can see the damages in real time and they can do things to try to minimize the causes of the damages. And that's a good business case for the insurance companies. So that's another element of an incentive that could be interesting to further explore. We haven't gone there yet." (Appendix A.5, 43:00)

It seems inevitable to use some resources for making projects tangible and establishing an understanding of the business domain of a single foreign actor. Incentives are easier to formulate if one can plan for short term wins to achieve long-term goals:

"it seems that there might be more, let's say, immediate success in focusing on a specific department and try to see what they have and may be even a department with good data source like Geo Data" (Appendix A.6, 38:14)

If we relate that to systems theory, Lasse S. Vestergaard suggests that systems should be broken into subsystems until their complexity is quantifiable and manageable. Then value is easier to formulate on an individual level.

If projects have a clear short-term goal then concrete action can be taken and value propositions can be made very visible. Ville Meloni also emphasizes that open data projects initially have to be concrete for an ecosystem to emerge around the data:

"certain entities have to put commitments to do something concrete so that it make sense and also invest time and sort of communications and develop with developers and with people from the ecosystem. Not only from the traditional IT companies but also people who are enthusiastic about it and just try to look at this ecosystem and you try to help different actors to understand and to do something concrete." (Appendix A.7, 12:40)

He further explains that the whole open data paradigm requires actors to understand, contribute to, and benefit from open innovation. Open data is indeed a means to break down silos – especially if concrete projects are formulated, which can grow bigger gradually as the open innovation grows and actors increasingly understand:

"you should not just open data that you think is good for business but you should open large kind of different types of data because you can never know because it's open innovation. You can't really know how somebody is using that but it helps to create new angles and new sort of innovation based on new ways of mixing different data. So, we have that in mind but definitely quick wins, if you can find quick wins and concrete use cases that you know could be solved, I mean some business problems that could be solved by doing something with the open data then you should look at those. (Appendix A.7, 27:25)

Ville Meloni goes on and describes how subsystems identification is a vital way to create incentives for actors to participate. After a while the project can be taken to a larger scale where the actors are able to find other actors and help each other mature: "Let's say that if I now collaborate and open my data, then I will some how benefit from it concretely. [...] You [have to] start small, take entities like individuals and organizations that really need this and see the benefit and really do invest the time and then you experiment with them and then share best practices before you take anything to large scale." (Appendix A.7, 24:19)

One way to foster open innovation and well-considered open data is to physically place potential actors next to each other and incentivize them to discuss and find synergies. Copenhagen Solutions Lab is doing something very correctly according to Lasse S. Vestergaard:

"that an interesting approach because this way what they do is, they actually try to assemble people from different departments within the municipality so they can sit physically together and hopefully they will talk together and figure out that; well we are doing stuff in parallel, and well, we can actually collaborate in this, and they are doing exactly the same. (Appendix A.6, 45:59)

We have previously mentioned that open data and open innovation is both an enabler to other data-driven smart city initiatives and at the same time it is a goal in itself that can lead to concrete value creation based on its aggregation with other open data. Ville Meloni here describes how understanding of the value of open data can function as an incentive in itself:

"I think open data is a way for different organizations and individuals to collaborate concretely. For example, in analysis or creation of digital services or just sharing and understanding. It's something concrete. It's like a fuel for these things. And if I think the cities from the public sector perspective, I think, one of the thing it has enabled is this, quite traditional organizations which might work in silos, it helps them to collaborate and it helps them to understand each other and helps them to understand how they function because they look at the data and they get different perspectives from their data" (Appendix A.7, 04:21)

5.3.2 Top-down versus bottom-up approaches

For a very long time, city development and planning has been dominated by top-down approaches but with the introduction of smart cities and emergence of technologies like Web 2.0, the bottom-up approach has gained lot of attention (Schaffers et al., 2012, p. 46). Involvement of people in defining and implementing solutions is argued to be the fundamental trend of smart cities (Schaffers et al., 2012, p. 53). One way involve people is by opening data and making it publicly available (section 1.1.2). We have also explained how open data can bring together smart city actors and catalyse smart city development (subsection 1.1.2). But there are still some questions unanswered regarding the implementation of open data initiatives/systems. Who are responsible for implementing these systems? who should initiate it? What approach fits the best (top-down or bottom-up)? We will now explore our primary data (interviews in Appendix A) to find answers to these questions.

Adrian Ulisse explains that there is a tendency of putting lot of effort in top-down approach while implementing big systems and this may decrease the possibility to understand the optimal value and impact it has: "Working for a big systems integrator, there is often a tendency to take a topdown approach and say that you can integrate all of these different systems, put lots of different sensors in the field, and it's all going to be great and wonderful. The question that often is not asked is: Why are you going to do that? What are the benefits? What are the impacts that are going to happen on this earth? Is a big top-down system the right way to go? I haven't had that experience. I thought: let's look at it from a different perspective and in a different way. With a more bottom-up approach, where you have got a predetermined position - you are just trying to understand what are the problems that we are trying to solve within the city." (Appendix A.2, 04:15)

From above statement, it can be argued that open data initiatives as big and complex systems need to balance top-down approaches and the bottom-up approaches. Manville et al. (2014) illustrate (figure 1.1 how top-down and bottom-up approaches can encourage the participation of citizens and stakeholders in the smart cities. They argue that a top-down approach provides a high degree of control and coordination among the actors in the smart city, whereas a bottom-up approach allows the participation of the actors in the smart city development process. According to systems theory, one way to approach such a complex system is to break it down into tangible and concrete projects (subsection 3.1.2) that can be developed by balancing top-down and bottom-up approaches. This can be seen as bottom-up system optimisation. Ville Meloni supports this by saying,

"I think, there is a test somebody has to do or certain entities have to put commitments to do something concrete so that it makes sense and also invest time and sort of communication and develop with developers and with people from the ecosystem." (Appendix A.7, 10:44)

This depicts that the development of open data subsystems requires a proper identification of concrete projects within the city. Henrik Korsgaard argues that the initiation of such projects should be top-down and "it should be the policy-makers that take the initiative to make people and actors understand that they can benefit each other by opening up data" (Appendix A.4, 19:25). Ville Meloni further supports this statement by indicating that cities are the main responsible actors for taking the initiatives. He explains it by saying,

"In the beginning, Helsinki and other metropolitan cities, they took the step to invest time and money in starting open data operations and concretely opening data. [...] .So, I think its the public sector players who actually invest time and money to open their data." (Appendix A.7, 13:35)

Adrian Ulisse explains the necessity of top-down approach in breaking the silo thinking of relevant actors and he also depicts it as a role of central government.

"I think central government has a point to play in this. The very nature of the central government is broken into silos - from ministry of transport to ministry of energy e.t.c. If you can incentivize local government by integrating at the central government level." (Appendix A.2, 16:15)

It can be argued that the initiation of open data initiatives should be done by governance bodies (i.e. top-down approach), or what Iansiti and Levien (2004) define as Keystones, and proper institutions should be designed to incentivise and create a suitable environment for other actors to get involved in the process. Ville Meloni explains his view by saying,

"I think it's public sector players who [should] invest time and money to open their data and I think it's not opening data for [just] opening data. It should be taken [into consideration] that when new IT systems are implemented there are open APIs by default [...] and make sure that it is also mandated and there can even be laws. Lot of this open data development is from grass roots level in the beginning, you have individual level at first and you then you have smaller companies doing something and then you have some well established IT companies who understand that this open data is good for their business." (Appendix A.7, 13:35)

All in all, it is about applying proper top-down approach and creating appealing environment for other actors (private sectors and citizens) to get involved and catalyse a bottom-up approach.

In section 2.3.3 we explained that open data is an innovation enabler and we also explained how an open data system can function as a platform for open innovation (section 3.4). Ville Meloni also indicates the benefits of open data and explains how opening of data can make work processes efficient and make the public and private sector more responsive.

"The logic is that in a closed system, whether it's closed data or closed source, which is not sharing information, it is very inefficient. In the future, there are lots of challenges, there is less money, things change more quickly, there is digitalisation. So you need to be more agile and we believe that one of the ways for that to happen is to open up your processes, open up your data and collaborate and work together. And that enables, hopefully, cost savings, better services and that also hopefully enables reacting quicker to whether it is citizens or company needs instead of being very closed and not cooperating." (Appendix A.7, 32:02)

There are lot of issues in setting up open data systems and one of the major issues is funding. Kristoffer Hvidsteen express the necessity of policy for funding open data:

"A policy initiative, like funding a platform where you propagate the data, I think is a fantastic good initiative to take." (Appendix A.1, 26:12)

It is crucial to identify the "innovation investors and benefactors" (3.4.2). Adrian Ulisse explains the powerful role of investors by saying,

"I think you have to use the financial leaders to encourage more integrative thinking and that might be by moving funding dependent on action" (Appendix A.2, 19:08)

Kristoffer Hvidsteen explains that the public sector should be able to provide funds in the absence of venture capital funds (Appendix A.1: 41:33) and also indicates a lack of confidence in the public sector as a major barrier for funding. He explains how this dilemma in public sector for opening data hinders the ability of private sector for initiating the project:

"So when you formulate a project and makes through to the different stakeholders and the different gatekeepers, if you come out with that crazy idea, if you at top have people sitting that are not used to using smartphones, that may not be tuned into these things, or if you somewhere along the system have somebody saying: That?s great, but you know, if we are to innovative and we end up with a shit project that is going to cost us millions and we have nothing to show, then we are all getting fired. The minister is going to be upset, or the major is going to be upset." (Appendix A.1, 51:32)

This indicates a need of *innovation benefactors* (Chesbrough, 2005), who focus on the early stage of the development and explores the value proposition of implementing such a system. This kind of primary research can incentivise and assure the investors (public sector) for funding open data initiatives.

The necessity of incorporating bottom-up approaches in an open data project has been already discussed. One way to take bottom-up approach is by involving citizens and other relevant actors in development process. Adrian Ulisse explains the necessity of the citizens perspectives to understand citizen needs and to incentivise them to involve in the development process.

"One of the things that we are looking at is how to encourage citizens to use their sensor devices in their smart phone to collect data on behalf of the citywhy would you do that? Share these data with government? It's costing some of my battery time. What are the benefits for me? That issue has not been thought through. But to go back to the point I started with: if you can make solving problems that are personal to citizens important and integrate that into what you are doing, then you stand a much better chance." (Appendix A.2, 21:53)

Similarly, Søren Kvist explains the necessity of understanding citizens problem by saying,

"If they are not provided with the right technology, people will not use it or they will use it in unintended way." (Appendix A.5, 27:20)

Citizen engagement is also viewed as a major factor in developing successful smart city initiatives (2.4.3). Lasse Vestergaard argues that,

"Conceptually, people should be able to participate in their own cities and do stuff more actively and I will say that open data can help quite a lot there." (Appendix A.6, 20:14)

Søren Kvist explains the plans of Copenhagen Connecting to involve citizens. He says:

"to make sure that we don't roll out solutions that are not going to be a success, we are going to make collaborations with people that are experts. It could be citizens and other key stakeholders in the city $[\ldots]$." (Appendix A.5, 30:50)

He further explains the goals of Copenhagen Solution Lab to support citizens:

"One of the main objectives of Copenhagen Solution Lab is to support citizens, so we don't build solutions that the citizens don't need $[\ldots]$. So this work that we are going to start up now is going to bring these different institutions together, for example the research institutions, in regards to make solutions that are viable that people can accept." The analysis of above statements clearly depicts the importance of involving citizens in open data projects but Adrian Ulisse also emphasizes that it is necessary to identify relevant actors in the particular project. He argues that sometimes it might not be necessary to involve citizens:

"Why wouldn't the private and public sector be collaborating together to solve a problem around the high street or parking or energy? You don't need citizen engagement for the obvious." (Appendix A.2, 26:50)

He also explains the reason for not involving citizens by saying,

"One of the reasons why I say it's difficult is that citizens are generally lazy. The majority of us are lazy and we will expect things to happen for us and wonder why things don't happen for us. The engagement with the citizen peace is important - has to recognize that we are lazy. If we recognize that, then we are able to understand which engagements are actually useful." (Appendix A.2, 26:50)

5.3.3 Maturity – a collective open data mindset

We want to briefly elaborate on the concept of maturity and hold the statements from the interviewees up against what we already know about maturity from the literature review, section 2.4. This is a crucial elaboration because the concept of maturity is the pivot of our research and we need to find out how to grasp the concept in an open data context.

While going through the nature of business silos breakdown in a smart city context in subsection 5.3.1 we repeatedly referred to a special kind of understanding of the value of holistic thinking. For initiatives based directly on open data or open data as an enabler of other data-driven smart city initiatives to become successful and sustainable, the actors have to be willing to share their data and take in the data of others and by that break down their business silo. They have to acknowledge that a mutual learning process regarding open data can lead to two-sided, sustainable, and valuable outcome. This understanding is what we now refer to as maturity, just as in the introduction of our thesis, section 1.1. One difference is that we now have confirmed our initial assumption about open data mindset maturity in a smart city context. Another learning is that there are different perspectives on and levels of this maturity: (1) the individual maturity of a smart city actor, (2) the collective maturity of the specific subsystem/project, and (3) the collective maturity of the whole smart city, which can be considered as an unreachable thing to measure and treat because of its complexity.

Furthermore there is a maturity factor regarding the understanding of data as such among the actors and finally there is the maturity or quality of the actual data to be opened. Even though our research is addressing the maturity of open data mindsets among smart city actors we are mentioning these factors because they seem like inevitable parts of mindset maturity. Increasing data maturity/quality is necessary for an open data mindset maturity to grow and vice versa. And the same applies to core data understanding.

Our usage of grounded theory in our research has enabled us to sketch up a taxonomy for open data maturity categories in smart cities. This is shown in table 5.1.

Category 1	The individual maturity of a smart city		
	actor		
Category 2	The collective maturity of the specific sub-		
	system/project		
Category 3	The collective maturity of the whole smart		
	city		
Category 4	Maturity towards understanding the core		
	data among the actors		
Category 5	The maturity or quality of the actual data		
	to be opened		

Table 5.1: Maturity categories in an open data, smart city context

What our interviewees say about maturity

We will highlight some quotes from the interviews that depict some of the maturity categories that we have identified.

Adrian Ulisse addresses how maturity categories 2, 4, and 5 are interlinked:

"The reality is that the majority of the data is poor quality so it's very difficult to use. The understanding of what problem you are trying to solve is not being thought through. So as they may publish one data element you can't solve the problem without other elements of data and that might be from the private sector, it might as well be from citizens.' (Appendix A.2, 23:20)

Kristoffer Hvidsteen also links that to maturity category 1:

"If you have good data capability and analytic capability you are able to understand the consumption much much better and meet those demands much more accurately. So opening up the data is one part of it but that just becomes a cloud of data. We need to be able to understand and contextualize it for it to have value.") (Appendix A.1, 16:10)

Adrian goes on and links that to the maturity of the whole city and depicts that as a constraint for maturity development in smaller parts of the city:

"Certainly, a government that stays being in power for more than two terms often doesn't want to change what it set up in the first term. So it takes another government to come in and change some of the institutions that it doesn't agree with. There is certainly something around that, I don't know what the answer is, but you can just see a mismatch between these institutions and the ability to have everybody to work together collaboratively." A.2, 37:23)

So the maturity of the city, municipality, or whatever institution that set up de facto rules and realms for collaboration have a big role to play. Even though this is a much harder kind of maturity to address and process:

"I think one of the biggest challenges in all this is the institutional frameworks that we set up that stop collaboration unintentionally." (Appendix A.2, 34:12)

Søren Møller Jensen has a spot on statement explaining what individual maturity (category 1) consists of:

"... you need to consider what would might incentives be for me to open up the access to that data for another company." (Appendix A.3, 08:18)

An actor can be considered mature if he is able to articulate direct incentives for him to open up data. This maturity is of course causal to the maturity of the other relevant actors in a subsystem and therefore categories 1 and 2 are causal.

Søren Møller Jensen goes on and explains that open data mindset maturity is about understanding how to exploit the synergies between sectors by means of data sharing. This requires category 2 maturity because several actors need to collaborate on this:

"you [have to] believe that you can actually gain something from trying to come up with new solutions even though you cannot formulate those new solutions in detail when you start out. I see the same with open data and the need to invent something. Sometimes if you have access to the data it's just a time effort to try to see what values lies within that data." (Appendix A.3, 21:16)

To be able to establish the required infrastructures for data collection and sharing the society also has to be mature to understand its justification. This is category 3 maturity which is dependent on category 4 maturity:

"It's not that difficult to figure out that if we build a highway what can we do with that. We can have cars and trucks and others driving on that. In that sense it's very easy. But when somebody suggests that we should use a truck loads of money on a wireless infrastructure [they think] why? Its not even visible. [A highway] is a physical construction. You can see it's there. We know what the money was spent on and we pay for it. I mean the society needs to be mature and that is society maturity when it comes to digitalizing products and services as well." A.3, 01:03:12)

Henrik Korsgaard also explains how an actor have to have the

"understanding that you might not be creating value that is directly returned to yourself but it is distributed along a very complex network of stakeholders." (Appendix A.4, 14:36)

He further depicts the necessity for category 4 maturity and how it is related to categories 1 and 2:

"if we talk about fixing some of the issues then get municipal case workers and employees and policy-makers and a lot of people within the governance bodies to understand what data is. This will be the first step towards actually discussing some of the social sustainable issues. [...] If you make decisions on it, you should be able to at least understand the landscape on a more detailed level that the current people do. And I think that would both ensure some sustainable growth but also a more sustainable business perspective as well." (Appendix A.4, 33:04-36:45)

Søren Kvist is elaboration on the role of data created by the public sector as a basis for open innovation. It has to be real-time data which is relevant and well-structured. This is indeed category 5 maturity:

"one of the main obstacles is that the data that we have and provide for students and companies is simply not enough. It is not enough just to open up our system data from the city, we have to provide real-time data, because it especially when we provide real-time data that you can actually make solutions that are interesting for business and entrepreneurs to build data-driven solutions on." (Appendix A.5, 32:16)

Lasse Vestergaard is also discussing this issue of category 5 maturity and he concretely explains the interdependencies between the quality of the data and the open data mindset maturity of the actors:

"to up the value or the quality of the data, that means having real time data and have it in structured format so that you can use the data directly within your apps because you have this API access so there is computational access to data or automatic access to data. So that is happening but that is going really slow and that is the first thing." (Appendix A.6, 12:21)

"So, if the quality of the data is not good enough you cannot create anything but if you don't understand the data it's really hard too because I guess you need to work from both sides: You need to have a better quality of data but you need to also get a better mindset for the better understanding of what you can do with the data." (Appendix A.6, 40:18)

He further depicts that the ideal smart city should think and behave as an organism – one can interpret that as the smart city should strive for working as an organisation. This is not possible from a complex city perspective but can be possible in a subsystem level:

"sustainability also comes in to the area of 'OK, How can we jointly do stuff and how can we be more like an organism?' So the city should be like an organism. That means everyone should essentially be able to help everyone." (Appendix A.6, 21:15)

5.3.4 Summarizing the findings

Summarizing the findings of three topics that were the result of selective coding (section 5.3), we can claim that sustainable development of smart cities requires the city actors to break down the silos, develop cross-sectoral thinking and become more agile and collaborate in new ways. Institutional design is pivotal in breaking down of silos and hence, ripping the value from the synergies between different cross-sector. Open data is a way of creating integration across silos and by that developing a sustainable collaborative environment for sustainable development of smart cities. This requires the smart city actors to open their data across sector boundaries. Despite understanding the value of cross sectoral open data, unaligned mindsets of the actors and quality of data are seen as big obstacles in opening and sharing of data. So, maintaining the quality of data and developing the mindset that understands the value of data and its exposure mechanisms are the major factors for silo breakdown. Furthermore, it has been identified to be unrealistic to realize the optimal value from whole open data paradigm at once. So, concrete projects with clear short-term goals should be formulated, which can grow gradually as the open innovation grows and a whole ecosystem emerge.

As a complex ecosystem, it is very challenging or almost impossible to optimize a city taking a system-wide top-down approach. Instead it can be started from a subsystems (systems perspectives) level and further extended to bigger systems level striving for whole city level. This we argued as a bottom-up system optimization. Looking into which approach to follow for open data system development, our findings depicts that a clear balance between a top-down approach and bottom-up approaches is needed. The development and deployment of open data initiatives/systems can be accomplished using top-down approach whereas further development and extension of system can be handled using bottom-up approach as it allows the participation of the citizens and other system actors, which eventually fosters open innovation. We have found that relevant actors for a particular project have to be identified.

At last, by analysing the primary and secondary data thoroughly we identified that there are different perspectives on maturity and it has to be considered on different levels (such as individual level, system level, city level) of smart city development. Based on this, we categorised maturity in to five categories (table 5.1). We also analysed how these maturity categories are interdependent. And finally we deduced that increasing all these maturity categories will lead to increase in the collective open data mindset maturity, which is an inevitable factor for developing smart cities holistically by means of open data.

5.4 The Model/Framework

In this section we will see to which extend we can make the normative model demanded by our research question and we will describe the background of its nature. We will initiate our description with the explaining the foundations of the model in section 5.4.1. We will show a model that summarizes our findings and pur them into perspective (figure 5.1. This model forms the basis of the development of a normative maturity model. In section 5.4.2 we will describe the necessity and the development process of the maturity model. In section 5.4.3 we will present and describe the core model (we call it the Open Governance Maturity Matrix).

Finally, in the sections 5.4.4, 5.4.5, and 5.4.6 we will thoroughly describe the different components and dependencies that constitute the Open Governance Maturity Matrix.

5.4.1 Fundamentals of the Model/Framework



Figure 5.1: Summary of our findings

On the basis of our knowledge gained from chapter 2 and chapter 3 we followed a certain path of a meaning condensation by performing constant comparison and reflection and identified some core topics. These core topics reflects the major concerns of our respondents (interviewees).

The topics have been condensed from relevant concepts (section 5.3), relating to our research area (section 1.2). All the primary and secondary data gathered depict concerns related to these topics. The first topic condensed, which actually is mentioned and emphasized by all the interviewees, is the uncertainty of not well-defined projects. The identification of concrete projects is pointed to be crucial for the development of an open data initiative/system. This we argued to be bottom-up system optimisation. The second topic condensed is the identification of relevant actors. Identifying potentially relevant actors is also crucial for the success of a project. The third category is concerned with breaking down business silos. Breaking down the silos within and between actors is crucial for the development of a collaborative system. The fourth topic condensed is the institutional design. Proper institutional design is as a means to minimize the *cooperation problem and the problem of collective action* (Koppenjan and Groenewegen (2005)) between the relevant actors while developing

a system (project). The fifth topic condensed is collective open data mindset maturity. Developing a collective mindset maturity among the actors enables holistic thinking within the open data system and makes the actors understand the value of cross-sectoral opening of data.

These five topics forms our basis for further discussion. On the basis of these five topics identified, we developed a model summarizing our current findings (figure 5.1). It shows the relationships between these five topics. The model outlines different subsystems along with a concrete open data project/subsystem. These systems consists of different actors (private, public, academia, citizens). The findings model depicts that some actors being in one system can actually influence other systems. This means that there are some actors who are related to more than one system and there might be some actors that are not a part of any systems. So, it is important to identify those relevant actors of the system/project. Identifying potentially relevant actors can help to better understand their needs and their interests towards the system or project. From the findings (section 5.3), we realized that to shape a collaborative system, it is necessary to breakdown the silos between relevant actors and this can be done by implementing proper institutional design. The model depicts the relationship between institutional design and silo breakdown. The silos can be broken down by implementing proper institutional design. Proper coordination between breaking down the silos and institutional design leads to collective mindset maturity. The figure (figure 5.1) also depicts that with the increased collective mindset maturity, systems can integrate with different other projects/subsystems and may form a bigger integrated system. This also illustrates a bottom-up approach where the smaller subsystems optimise and integrate to form a optimised big system (depicted by dotted triangle in the figure 5.1).

The "basic social process" (Jones and Alony (2011)) identified in our research is the process of increasing the maturity of the collective open data mindset. We have found that breaking down the silos by implementing proper institutional design enables this collective maturity among the actors.

With this evaluation and summary of the findings we have increased our knowledge about the subject matter. So, at this stance, we have moved a step further in hermeneutic circle (Malpas (2014)) and got to a new standpoint. Furthermore, this model (figure 5.1) describes what is needed to develop a collective mindset but it does not explain concretely about how to create the collective mindset and how to increase the maturity of the mindsets i.e. it does not describes the action plan and is not normative. Instead this findings model (figure 5.1) forms a very good foundation for the development of an action model. It forms a basis for the development of an action model that can be used as a normative reference for collectively maturing the mindset of actors. This will fundtion as a normative model that can enhance the collaboration among the actors for cross-sectoral open data development by maturing their mindset collectively. The development process of the normative model is described in section 5.4.2.

5.4.2 Normative model/framework for open data mindset maturity

In this section we will describe how we can create a normative model for increasing open data mindset maturity and we will go through the development process.

Based on our primary data we argued that there is a necessity of developing such a model and that such a model can fill a gap in the current smart city discourse. Søren Kvist emphasizes the necessity of a maturity model by saying,

"A maturity model is definitely something that could fit into the governance way of creating a roadmap for a smart city." (Appendix A.5: 01:04:40)

Although a convincing amount of research is being done in regards to open data, the field of maturity model design is underexposed in both academic as well as non academic world. There are some research institutions like Gartner (subsection 2.4.5) and researchers like Tauberer (subsection 2.4.6) that have developed maturity models related to open data but these models are either only available for specific clients or are limited to specific areas and does not incorporate all perspectives of open data maturity (table 5.1). This leads to the necessity for the development of a normative model, which actually can give some guidelines for actions (increasing collective open data mindset maturity). Thus, based on our meaning condensation and findings model (figure 5.1), we will create a theoretical normative framework for sustainable open data collaboration – a sustainability which is reached by increasing the collective maturity of the system actors.

In section 2.4 we reviewed the concept of maturity from different perspectives by exploring different maturity models. We also realized that there are different varieties of maturity models, some models describes the current state of the subject matter, while other models advance to another level by actually providing suggestions on how to increase the maturity. The "Architecture Maturity Matrix" (subsection 2.4.2) is the only one which constitutes action model for assessing the maturity stage as well as providing a concrete guidance for incrementally maturing an organisation from an EA perspective.

The format of our model is inspired by the "Architecture Maturity Matrix" (figure 2.9). Following the same design pattern as the Architecture Maturity Matrix, our model forms an instrumental framework that provide guidelines for maturing the mindset of involved actors and by that fosters the development of an open data system that can be integrated with other systems. Moreover, with an action framework like this, an open data initiative can live up to the conditions that we have identified for cross sectoral open data development. Furthermore, this model will incorporate open governance approaches (as described in section 2.3.1) so that all the relevant actors can have open access to the model and all the actions can take place in a transparent environment. By keeping such a framework open to all the relevant actors they have the possibility and incentives to accelerate the maturing process and it ensures that all the actors have the same understanding of what maturity is, which is also very important. Furthermore, the actors have an incentive to collaborate and help to collectively increase the maturity of their mindsets. It is an incorporated premise of the model that such alignments of mindsets should happen in collaboration – therefore, we call the model an Open Governance Maturity Matrix. In this way this model can provide incentives to collaborate, which allows the long-term goals to be envisioned and rebound effects to be minimised.

5.4.3 Explaination of the Open Governance Maturity Matrix (Table 5.2)

As described in section 5.4.1, the findings model illustrated in figure 5.1 forms a foundation for development of *Open Governance Maturity Matrix*. The model is showed in table 5.2 on page 92 and it consists of three dimensions. The first dimension includes *three* subjects (elaborated on in subsection 5.4.3). As explained in section 5.4.1, these subjects are condensed from the primary data gathered and these are the most main areas that should be considered while developing an open data system/project. The second dimension consist of *eight* maturity stages (detailed description in subsection 5.4.6) that includes the overall maturity levels. Finally, the third dimension consists of *four levels* for mindset maturity of all relevant actors (Actors dependency (D1)). It is essential to incorporate the mindset maturity of all relevant their relevance, competencies, and behaviour.

Maturity Subjects	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7	Stage 8
Concrete/well- defined project (S1)	The project has a clear vision.	Resources required for the project are clearly identified.				The project has defined concrete short term wins along with a long term outcome.		The project is scalable and it can be integrated with other projects.
$Relevant \ actors \ (S2)$		The poten- tially relevant actors for the project has been identified.	The actors are able to define their specific roles.		Based on their specific roles, the actors are able to optimize their work processes.		The actors have the ability and willingness to cre- ate incentives for other actors to progress in the participation.	
Proper institu- tional design (S3)				Requirements for various actors have been identified.	Objectives and constraints have been formulated from the identified requirements.	Proper policies and norms are developed based on the objectives and constraints formulated.	Policies and norms can be changed according to the need.	
Actors depen- dency (D1)			- I understand the project and its value proposition? - I understand what open data is in this particular project?	- The provided in- centives are satis- fying for me? - The value propo- sition and the incentives coun- terbalance the risks of changing environments?		I am willing to and capable of sharing my data in a standardized way and I under- stand the bene- fits?	I understand how to benefit from integrating this project with other projects?	

 Table 5.2: Open Governance Maturity Matrix

CHAPTER 5. ANALYSIS

92

The key components of the model/framework

Unlike the Architecture Maturity Matrix (figure 2.9), which basically uses three key components to analyse the maturity state, the Open Governance Maturity Matrix (table 5.2) uses four key components to analyse the maturity state because of the complex nature of open data systems.

The four key components, also depicted in table 5.2, are:

Subjects

This includes the list of focus areas/subjects. Based on our findings (section 5.3) and the model summarizing our findings (figure 5.1) three subject areas (Subjects) are identified:

- S1: Concrete/well-defined project
- S2: Identification of relevant actors
- S3: Proper institutional design

Descriptions of these subject areas are presented in section 5.4.4.

Subject's Maturity Levels

Each subject consist of maturity levels starting from lowest maturity levels to highest maturity levels. In total, the maturity matrix (table 5.2) consists of 12 different maturity conditions, each depicting certain levels of maturity for each subject. These conditions and their relevance are described in section 5.4.4. For every subject the maturity conditions should be achieved from left to right. It is not possible to achieve higher level maturity conditions without achieving the preceding maturity conditions. The stage at which the certain maturity conditions should be met are presented in the maturity matrix (table 5.2). The position of the conditions also depicts the subjects that should be developed or considered first before developing other subjects. For example, the subject 'concrete/well-defined project (S1)' has a condition - 'The project has a clear vision' at Stage 1, whereas, the subject, 'identification of relevant actors (S2)' has a condition - 'Resources required for the project are clearly identified' at Stage 2. This means the condition for S1 should be met before the condition for S2.

Maturity Stages

It forms the horizontal component which shows the overall maturity of the collaborative mindset maturity among the actors. The eight columns represents the maturity stages progressing from value 1 to 8. Following conditions should be met to reach the certain stage of maturity.

- 1. All the required maturity levels in a particular maturity stage should have been reached.
- 2. All the required maturity levels in maturity stages preceding the current maturity stage should have been reached.
- 3. Not all maturity levels for the later maturity stages have been reached.

Thus, to be in the maturity stage 2, the conditions - 'The project has a clear vision' and 'Resources required for the project are clearly identified', should have been achieved for Subject 1, and the condition - 'The potentially relevant actors for the project has been identified', should have been achieved for Subject 2. So, when all the conditions in stage 2 have been achieved, then it is time to develop the required subjects for next stage. In this way this model can also be used to set priorities for maturing the collaborative mindset.

Actors dependency (D1)

This component also consists of maturity levels interdependent with maturity levels of the subjects (S1, S2, S3) but these levels are obtained on the basis of questionnaires (a detailed explanation is presented in section 5.4.5) for relevant actors, presented in table 5.4. Due to its interdependency with the maturity levels of Subjects S1, S2, and S3, the first condition for this dimension should be met in stage 3 of maturity matrix (table 5.2).

Multi-level Open Gov- ernance conditions	Level A	Level B	Level C	Level D
Concrete/well- defined project (S1)	The project has a clear vision.	Resources required for the project are clearly identified.	The project has defined con- crete short term wins along with a long term outcome.	The project is scalable and it can be integrated with other projects.
Relevant actors (S2)	The potentially relevant actors for the project has been identified.	The actors are able to define their specific roles.	Based on their specific roles, the actors are able to opti- mize their work processes.	The actors have the ability and willingness to create incentives for other actors to progress in the participation.
$\begin{array}{ccc} Proper & institu-\\ tional & design \\ (S3) \end{array}$	Requirements for various actors have been identified.	Objectives and con- strains have been formulated from the identified requirements.	Proper policies and norms are developed based on the objectives and constraints formulated.	Policies and norms can be changed according to the need.

 Table 5.3: Open Governance Maturity Conditions

5.4.4 The three subjects of consideration for maturing the open data mindset collaboratively

On the basis of our primary and secondary data we identified three subjects that should be considered for maturing the collective mindset of the actors (subsection 5.4.3). Within these three areas we have defined different maturity levels (table 5.3). Every maturity level for each subject is assigned with certain conditions. Furthermore, for making it easier to explain and convenient for the reader to understand, these conditions are assigned with different characters from A to D. For example, the first three conditions of each subject is assigned with character A and called 'level A' (as depicted in table 5.3). These maturity levels are arranged in a manner so that the higher maturity levels cannot be achieved without achieving the preceding maturity levels. For example, it is not possible to promote to 'level D' without fulfilling the conditions for levels A, B and C, respectively. In this section we will elaborate on each subject along with their four maturity levels and the required conditions.

1. Concrete/well-defined project

As per our findings, the projects related to open data are mostly fuzzy with unclear goals and approaches. This is due to the complexity of the open data subsystem. So, in the beginning it becomes important to understand how well the project is defined.

Level A The project has a clear vision

The project should have a clear vision of the ultimate condition or desired state that it wants to achieve. A clear vision also provides the successive steps for moving the project forward.

Level B Resources required for the project are clearly identified

The resources (such as funding) for the project should be allocated. For example, from our findings we can argue that the initiation of the project should be done by the public sectors (top-down) by allocating the resources, at least for initiation of the project (subsection 5.3.2).

Level C The project has defined concrete short term wins along with a long term outcome

The project should be able to provide small short term gains that can act as an incentive for the actors to participate more actively from the beginning and keep motivated towards the final outcome of the project. In case of a project with a clear short term goal, value propositions can be made clearly visible.

Level D The project is scalable and can be integrated with other projects

The whole idea behind maturing the mindset of actors collaboratively is to realize the optimal value from cross-sectoral opening and sharing of data. To incorporate this, the project should be scalable so that it can be integrated with other projects and an ecosystem can be built with understandable value propositions that every actor can benefit from.

2. Relevant actors

The projects dealing with open data typically have trouble with the identification of relevant actors. It is particularly necessary to identify relevant actors that actually influence the development of project in different levels. It might not be necessary to include all the actors at all the levels of project development. The Open Governance Maturity Matrix is supposed to be controlled by governance bodies, knowledge institutions, or consortia that govern the development of open data systems. It is their responsibility to identify the relevant actors for the project/subsystem. For example the Danish consortium CLEAN can be seen as innovation missionaries whose job is to identify the relevant actors and assemble them for development of cross-sectoral open data systems.

Level A The potentially relevant actors for the project has been identified

The first thing is, to find out who are the relevant actors for the project. It is also necessary to identify what are their roles and how can they support the project. Identification of relevant actors makes it easier to communicate with them.

Level B The actors are able to define their specific roles

After identifying the relevant actors it is necessary for the actors to be able to understand their specific roles in a particular project. For example, if a public institution is providing some kind of data, then it should understand its role of providing the data in a standardized way.

Level C Based on their specific roles, the actors are able to optimize their work processes

In this level the actors must be able to optimize their way of working so that it motivates other participants in the project. For example, if a public institution is providing some kind of data for private sector, then it should be able to advance itself with new technologies that can transfer data more efficiently in standardized formats.

Level D The actors have the ability and willingness to create incentives for other actors to progress in the participation

In this level the actors should be matured enough to understand the optimal value of the project. They should be able to create incentives for other actors to participate and mature so the collective maturity can increase. For example, by providing funding for an open data infrastructure and by providing open government data in highly standardized way, public actors can attract private actors for collaboration and vice versa.

3. Proper institutional design

From our findings (section 5.3), it can be seen that improper institutional design is one of the major problems in maturing the collective open data mindset among relevant smart city actors. Proper institutional design can break down intra-organisational as well as inter-organisational silos by establishing coordination and cooperation among the actors. We will take the *Meta model for Institutional Desgin* (figure 3.6) as a basis for developing the required conditions in this Subject area.

Level A Requirements for various actors have been identified

Every participant in a project is motivated by its own interest. It is important to identify their interest for participation and create a list of requirements, which is a first step while designing institutions (figure 3.6).

Level B Objectives and constraints have been formulated from the identified requirements

When having the list of requirements, it can be identified what supports the objectives of the project and what acts as a constraint for the project, which is a second step in designing institutions. As described by Koppenjan and Groenewegen (2005), these objectives and constraints can also be tested by involving experts and stakeholders before developing the policies and norms.

Level C Proper policies and norms has been developed based on the objectives and constraints formulated

Based on the identified objectives and constraints, proper policies and norms that support the overall goal of the project are developed. Furthermore, if needed, agreements are made between different collaborators for respecting the values of others. While developing such policies and norms one should be also aware that the focus on the solution to a certain problem must not create another.

Level D Policies and norms can be changed according to the need In this level the institution (policies and norms) should be robust. The policies, norms, and agreements should be changeable with the change in structure of the project as well as the change in environment. This level can almost be considered as utopia but still something to strive for.

5.4.5 Explanation of actors dependency (D1)

Actors mindset maturity (actors dependency) forms key component in our model and can be viewed as a third dimension in the *Open Governance Maturity Matrix* (table 5.2) and is denoted as D1. Before getting into more detailed explanation of this dimension, it is crucial to explain the *Project Questions For Relevant Actors* (table 5.4) and the *Open Data Working Questionnaire for Actors* (table 5.5), which forms the basis for this dimension.

Q1	I understand the project and its value proposi-
	tion.
Q2	I understand what open data is in this particular
	project.
Q3	The provided incentives are satisfying for me?
Q4	The value proposition and the incentives coun-
	terbalance the risks of changing environments?
Q5	I am willing to and capable of sharing my data
	in a standardized way and I understand the ben-
	efits?
Q6	I understand how to benefit from integrating this
	project with other projects?

Project questions for relevant actors (table 5.4)

 Table 5.4: Project Questions For Relevant Actors

The Project Questions for Relevant Actors consists of six question that evaluate the mindset maturity of identified actors. It depicts the mindset maturity of specific actors. All the questions are made easy to understand and can be answered by saying Yes or No. Now, we will explain the relevance of these questions based on our findings (section 5.3). All these questions are build on a combination of the statements of the interviewees regarding open data projects and our secondary data.

I understand the project and its value proposition? (Q1)

It is critical for the relevant actors to understand the project and its probable outcome. Without this level of mindset maturity, an actor is not able to understand what value is being provided.

I understand what open data is in this particular project? (Q2)

It is important to understand what open data is in context of the particular project. The actors should be able to understand what data they have: Is the data useful for this particular project? Do they have enough data needed? Do I understand the data of other actors? Do I understand basic open data technologies?

The provided incentives are satisfying for me? (Q3)

The actors should be able to identify the incentives that drives them towards the project. They should also be able to realize how satisfying the incentives are for them. By identifying and formulating their own incentives, making them open, and by trying to fulfil them (may be by negotiating with other actors) an actor can motivate oneself to participate actively in the project. At the same time other actors can provide the necessary incentives.

The value proposition and the incentives counterbalance the risks of changing environments? (Q4)

With the change in environment (change of investors, change in number of relevant actors and other unfavourable and undesirable conditions), the actors should be agile and should be able to change the perspectives along the way. The actors are also able to outweigh the risks by considering the value proposition and the incentives. This keeps the actors motivated towards the development of the project.

I am willing to and capable of sharing my data in a standardized way and I understand the benefits? (Q5)

The actors are ready to share their data and resources with other actors. It is not only enough to show eagerness of sharing but the actors are also able to share the data in standardized and mature format so that it can be easily used by others. Furthermore, the actors are able to understand their benefits of doing it throughout the project.

I understand how to benefit from integrating this project with other projects? (Q6)

The actors are capable of thinking in cross-silo manner and are able to see the new connections. Furthermore, the actors are capable of challenging their own competencies pro-actively by maturing their mindset. By that the actors are also able to see the benefits of integrating different projects and optimising them holistically to end up with real sustainable outcomes.

Open Data Working Questionnaire for Actors - D1 (Table 5.5)

The six questions developed in table 5.4 are used as a questionnaire for the relevant actors. These questions are further divided in to four levels (A to D), according to their relevance, so that it fits in to the Open Governance Maturity Matrix (table 5.2). We will briefly explain how these questions are set into different levels and their interdependence with maturity levels of the Open Governance Maturity Matrix.

Actor mindset maturity	Question	Yes	No
Actor mindset maturity Level A Level B Level C	Q1		
	Q2		
Lovel B	Q3		
Level D	Q1 Q2 Level A Q2 Q3 Level B Q3 Q4 Level C Q5 Q6		
Level C	Q5		
Level D	$\mathbf{Q6}$		

Table 5.5: Open Data Working Questionnaire for Actors (D1)

Level A

Question Q1 and Q2 are set in level A. An actor should be able to answer Yes to both Q1 and Q2 for being mature enough to be in Level A. The reason Q1 and Q2 are set in the same level the that actors must be able to understand the project but as it is the project related to open data, the actors must be also able to understand it from an open data context. Only in this only the actors are able to properly understand the provided incentives and answer questions Q3 and Q4. Level A is set for D1 at stage 3 of maturity matrix (table 5.2) because it is obvious that the value of actors can be only tested once they are identified.

Level B

Questions Q3 and Q4 are set in level B. An actor must be able to answer Yes to both Q1, Q2, Q3, and Q4 for being mature enough to be in Level B. The reason Q3 and Q4 are set together is that both questions are dealing with understanding the value of the provided incentives. Without finding the incentives satisfying an actor will not be interested in analysing its benefit.

Level C

Question Q4 is set to level C. At this level the actor must be able to share its data in a standardized format and understand the benefit of doing it. This enhance the actor to look forward and aim for next level of maturity i.e. level D.

Level D

Question Q5 is set to Level D. In this level, the actor must be able to answer Yes to Q5 and all previous questions and by that the actor must be able to understand the benefit of integrating with other projects and also should be able to optimize itself.
Maturity Subjects	Stage	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7	Stage 8
S 1	A	В				С		D
S2		А	В		С		D	
S3				А	В	С	D	
D1			A	В		С	D	

5.4.6 Detailed explanation of maturity stages

 Table 5.6: Open Governance Maturity Matrix (conditions replaced by characters)

After describing all the required key components, factors and maturity levels we will go through all the maturity stages in the Open Governance Maturity Matrix (table 5.6). We will explain the reasoning behind the placement of different conditions in different maturity stages. The placement of the conditions in the various stages is based on our analysis of the gathered (primary and secondary) data. By doing this we are showing how such a model works and how such a model can act as a conceptual model that gives normative guidance to maturing the collective mindset of the actors. To make it easy to explain and understand we have assigned different characters (as depicted in table 5.6) for different maturity levels instead of the conditions (as depicted in table 5.2).

Stage 1

We introduce our Maturity Stages with Stage 1. The first step in developing an open data project/subsystem is to identify and define a project and the project must have a clear vision and a goal. As we have to start at some point, we assume this to be Stage 1 of collaborative mindset maturity. This sets Maturity Level A for Subject 1 (S1) in Stage 1.

Stage 2

After identifying a project with a clear vision and a goal, the next step is to identify the resources required for the project. The resources also include the stakeholders so it becomes essential to identify the potentially relevant actors. This sets Level B for S1 and Level A for S2 in Stage 2.

Stage 3

The maturity of the identified potentially relevant actors can be evaluated using tables 5.4 and 5.5 in combination. The actors must be able to understand their specific roles in the project by understanding the project, its value proposition, and open data in this particular context. This sets Level B for S2 and Level A for D1. Furthermore, as the project contains multiple stakeholders there is a necessity for institutional design to get rid of *'cooperation problems'* and *'the problem of collective actions* (section 3.3.1). Following the design process for developing institutions (figure 3.6) the next step is to identify the requirements of these stakeholders.

Stage 4

After identifying the potentially relevant actors, the requirements of these ac-

tors are identified. Furthermore, the actors must be able to evaluate if the incentives and value propositions outweigh the risks involved in changing. This sets Level A for S3 and Level B for D1. As the requirements from the relevant actors are identified, the objectives and constraints can be formulated from these requirements to move forward in institutional design process (figure 3.6).

Stage 5

After obtaining the requirements, these requirements can be analysed to formulate the supportive objectives and constraints from different actors. The actors that matured to Level B of D1 can optimize their work processes. This sets Level C for S2 and Level B for S3. The formulated objectives and constraints can be tested by involving experts and stakeholders and proper policies and norms can be designed (figure 3.6).

Stage 6

When the actors are able to specify their roles and optimize their working processes. The project should be able to define some short-term wins, which keep the actors motivated. At the same time proper policies should be developed that urge the actors to work collaboratively. At this point, the actors also should be able to realize their potential for sharing of data in standardized way. This sets Level C for S1, S3 and D1.

Stage 7

Now, being in maturity stage 6 the actors can actually create incentives for other actors to participate because they understand the long term benefits of collaborating with open data and integrate with other projects. The established policies can be changed according to the changing integration and collaboration. This sets Level D for S2, S3 and D1.

Stage 8

After being matured optimally in all other subjects and the mindsets of the individual actors are also matured optimally the project can be integrated with other projects. At this point the actors have a collectively matured mindset. This sets D for S1. Thus, increasing maturity level to Stage 8, which is the final stage for maturity.

5.4.7 Possible working Model/Framework

In this section, we will elaborate on how the Open Governance Maturity Matrix possibly can be applied. Figure 5.2 demonstrates how the maturity matrix can be depicted in a three dimensional cube. This is a possible way to use and present the Open Government Maturity Matrix (table 5.2) for maturing the mindset of actors collectively. The figure clearly depicts the three dimensions i.e. Subjects, Maturity Stages, and Actors dependencies in three axes. In this particular case, the dimension *actors dependencies* depicts three actors, which is only for demonstration and may vary depending on the project and its progress.

							/	stand how
							tand how	I undersit if this er to be reading other integration with projects? projects? projects? projects?
	Stage 8	The project is scalable and it can be integrated with other projects				derstand how	Lunderst fruis to benefing this to benefing other to berefing other to berefing other to benefing to and projects? and projects?	I am will of a capable in a and capable in a and ray data way ny data way and the understand underst?
	Stage 7		The actors have the ability and willingness to create incentives for other actors to progress in the participation.	Policies and norms can be changed according to the need.	~	I unonning to the to berativith projects? projects? and and and and and and and and and and	l am ble of a and cap data way standard withe standard withe understand underst?	bein ad incentive
	Stage 6	The project has defined concrete short term wins along with a long term outcome.		Proper policies and norms are developed based on the objectives and constraints formulated.		l all able in y a cap data way a my dard way a standstand underts? benefits?	vided incentive	The provides for sition are satisfying proposition are satisfying proposition the proposition the the proposition the proposition of the the proposition of the proposition of the proposition of the the proposition of the proposition of the proposition of the the proposition of the proposition of the proposition of the the proposition of the pr
	Stage 5		Based on their specific roles, the actors are able to optimize their work processes.	Objectives and constraints have been formulated from the identified requirements.		o provided incentive for me?	The proving positives are satisfying propositives are value protives international protocol and the palaging and the palaging out of char?	cours of series risks on the the alue environment the value environment and the volection what propertant in this propertant is niect?
orages	Stage 4			Requirements for the various actors has been identified.		The satisfy proposes are satisfy proposes the value proposes the the parameters and the parameters count of chang risk former the environment the are stand the value	Lunder and what proposition what proposition what proposition Lunder and what proposition Lunder and project?	unen dat pro opericular pro particular
	Stage 3		The actors are able to define their specific roles.			I unoct aion. what proposition. what proposition withis proposition withis proposition within the understand withis open citation within the open citation the open citation citation the open citation the open citation the open citation the open c	Pla	Actor (A3)
	Stage 2	Resources required for the project are clearly identified.	The potentially relevant actors for the project has been identified.				Actor (A2)	cie ^s (^{D1)}
	Stage 1	The project has a clear vision.			an ur an	Actor (A1)	Actor	
		Concrete/well-defined Project (S1)	Relevant Actors (S2)	Proper Institutional Design (S3)				
			Subjects					

Figure 5.2: Open Governance Maturity Matrix (possible working model/framework)

Each grey rectangular cube contains a condition (Maturity Level of Subjects) and each green rectangular cube contains questions for measuring the individual actors mindset maturity. It can be seen how we assure that the individual mindset maturity and the overall project maturity are interdependent. Every horizontal layer depicts a maturity stage.

To be in Stage 1 a clear vision must have been identified. After stage 1 is achieved

one can strive for achieving the maturity stage 2, where two different conditions for subjects S1 and S2 has to be achieved. Similarly, to be at stage 3 the actors must be able to define their specific roles and be also able to say *Yes* to questions in the same horizontal level i.e. 'I understand the project and the value proposition and I understand what open data is in this particular project'.

By achieving the other conditions in higher stages and answering *Yes* to the questions aligned horizontally in each stage, one can achieve the higher stages of maturity. In this way, this model can be used practically as an open governance reference model in an open data project for maturing the collective mindset of actors and the total maturity of an open data system.

Chapter 6 Discussion

In this chapter we will discuss our findings and the Open Governance Maturity Matrix in a broader context. Many questions arise and seem unanswered regarding our findings and we will try to discuss some relevant aspects of them. At the same time we will discuss whether we are able consider some of our findings as grounded theory, and if so, we will present the grounded findings in a generalised and workable manner and discuss how it can be used in future research.

That will enable us to discuss to which extent we have answered our research question and come with suggestions to future research that can verify and validate our findings.

First we will explain how the Open Governance Maturity Matrix for developing a sustainable open data collaboration between relevant smart city actors corresponds and lives up to the theory that we have have presented in chapter 3. This will provide the reader with an understanding and justification of the underlying ideas of the Open Governance Maturity Matrix. It is also important for us to show how the maturity matrix merge the well-founded presented theories and the ideas of the experts that we have interviewed.

After that we will go through the some of the mentioned relevant emerging unanswered questions regarding the maturity matrix and open up for a wider discussion.

6.1 Theoretical Justification of the Open Governance Maturity Matrix

We will go though each of the theoretical areas presented in chapter 3 and discuss to which extent our grounded findings live up to this theory. This will function as a *verification* our findings and the Open Governance Maturity Matrix. As to our grounded theory approach we are not obliged to *validate* our model but this section will enable us to indicate how it can be validated in the future.

Systems Theory

One of the points we deduced primarily from Ackoff (1971) and Luhmann (1982) was that a complex system such as a society – or more concretely a city – needs to be broken down in smaller better defined, tangible subsystems. These subsystems

do not necessarily have to have a well-defined set of actors and relations but they need to be defined and conceptualised in ways that enable them to be considered as purposeful and ideal-seeking. If such a system can be defined and developed then it is optimisable. One can relate to the concept of maturity and claim that a true ideal-seeking system corresponds to the highest possible collective maturity level of an open data project in a city context. Let us explain how the Open Governance Maturity Matrix can contribute to the determination of subsystems, collection of system reactions and responses, and system optimisation that strives for ideal-seeking conditions which again catalyse silos breakdown and holistic open data collaboration.

Stage 1 in the maturity matrix requires a potential project to have a clear vision, and so it is immediately initiating a subsystem formation, which does not have to be clear yet. As the project moves on, the objectives and constrains can be addressed and new norms can evolve because the actors increasingly get more aware of their specific role (Stages 2-8).

As explained in the findings, section 5.3, one incentive to participate in open data collaboration is quick, short-term wins, and this issue is addressed in the dependency D1, where incentives have to be found and aligned among the actors for the process to move on. This will catalyse specific open data collaboration incentives and the subsystem will gradually become more well-defined because possible system reactions and responses will be identified by encouraging actors to communicate and compromise so everyone thinks the value proposition and incentives counterbalance the risks. When incentives and obstacles for collaboration and communication are addressed, our maturity matrix will automatically lead to an evaluation of these and thus, as the system gets more well-defined, it also leads to system optimization. An optimization that has an *idealistic* goal, which is pursued systems.

Ecosystems Theory

A business ecosystem is another way to describe the wanted purposive, ideal-seeking system. The Open Governance Maturity Matrix makes sure that a business ecosystem is created around specific visions and subsystems within the city. The maturity matrix is addressing the necessity for public/private ecosystem leadership by means of a mediator cluster organisation. Through the eight stages of maturity the four stages of business ecosystems given by Moore (1993) are also traversed: first we have birth, then there is an expansion, and at last the project will reach a self-renewal stage where the collective ecosystem mindset is agile and constantly seeking synergies to overcome external threats.

It is relevant to discuss how the stage of business ecosystem leadership is handled in our maturity matrix. We have identified the initial leader to be a cross-industry cluster organisation like Copenhagen Capacity or the CLEAN cluster, which represent many different interests and understand the need for a holistic approach. They are the obvious keystones and regulators of ecosystem health. But business ecosystems are according to Moore (1993) in constant competition with other ecosystems and this is not necessarily the case for open data ecosystems within smart cities because the public sector is an inevitable actor. And so, if leadership is given to

Example of a system *re-action*: If opening up certain data in a certain way with out a doubt causes another actor to open up certain data. Other reactions will then occur, such as rebound effects.

Example of a system *re-sponse*: When funding is a vital catalyst to actor participation but not sufficient.

a private actor it might be more effective in the short-term, but the incentives to do holistic decisions might disintegrate unless a high collective maturity is reached. Therefore we argue that cluster organisations should maintain their ecosystem leadership as long as possible or until the current institutions are properly redesigned.

Institutional Theory

Institutions include the norms, policies, constitutions, and behaviour surrounding the ecosystem. One of the underlying purposes of the Open Governance Maturity Matrix is to design and evolve institutions that are beneficial for open data collaboration. The maturity matrix is built on many of the ingredients to proper institutional design given by Koppenjan and Groenewegen (2005). An important part of institutional design is stakeholder identification, which we address in the maturity matrix.

Furthermore, their meta-model includes development of requirements and formulation of objectives and constraints, which we have translated into an overall vision and obstacles and incentives for open data collaboration.

They emphasize the importance of performance indicators when doing institutional design. Our maturity matrix does not mandate performance indicator considerations but can function as a generic performance indicator in itself. Even though Boyd-Cohen writes that performance indicators must not and cannot be generic on a city level, it is possible to use our maturity matrix on a subsystem level. This, of course, does not prevent performance indicators to be used along with the maturing process.

Open Innovation Theory

Open data collaboration is inevitably dependent on a strong platform for open innovation where ideas can be collected and refined and reach the socio-technical system (Schaffers et al., 2011). One of the goals of open data is to expose information in an agreed, standardized way for example in an open API, which is free to be used by companies and entrepreneurs. The Open Governance Maturity Matrix ensures that these standards are agreed upon by relevant actors. At the same time it provides collective incentives for these actors to break down their business silos and find synergies between their business domains - this can also be considered as open innovation where purposive inflows and outflows result in projects with innovative outcomes.

When the project reaches a high maturity level it is ready to integrate with other projects which catalyse new forms of open innovation. A more in-depth discussion of the possibilities for a systems integration process will come in subsection 6.2.1. Chesbrough (2003) emphasized the importance of proper funding of open innovation and this issue will be covered more in depth in subsection 6.2.2.

Open innovation is further catalysed because the maturity matrix assembles the four different types of organizations needed for innovation generation: Innovation explorers will typically be public institutions, merchants will primarily consist of private actors looking for economic benefits but will also be presented by public actors, architects will be the supplier of complex technologies, and the initial missionary will be the keystone cluster organisation. The Open Governance Maturity Matrix generates a platform for all these types of actors to collaborate and it also provides incentives for them to participate.

6.2 Practical Concerns Regarding the Open Governance Maturity Matrix

As we have previously indicated, there might be some unanswered questions regarding the practicalities of the Open Governance Maturity Matrix. In section 6.1 we explained how the maturity matrix can be justified from a theoretical and methodological point of view and it has always been out of our scope to justify the maturity matrix from a practical point of view. Nevertheless, we want to discuss and elaborate on some urgent practical concerns in the following subsections.

6.2.1 Maturity concerns while integrating to other open data projects

In section 5.4 we argued that integration to other open data collaboration subsystems can happen when a certain maturity stage is reached. At that point the actors understand how to think holistically and long-term incentives for "opening up" are provided, which leads to a sustainable, ideal-seeking ecosystem. But we have not considered the impact of and necessity for a collective maturity of the adjoining project. The adjoining project/subsystem is probably at another maturity stage and maybe it is not even using any maturity framework to measure its collective maturity. Will it even make sense to integrate then?

We cannot provide any scientific evidences that says whether or not the two subsystems will successfully integrate or what shall be done to ensure a successful integration. We can only relate to our grounded findings and argue that the new system has to initiate a new maturing process. New actors have to be identified and their mindsets have to be aligned and understand the incentives to participate in an open data collaboration. The integration process might work faster than an initial maturing process because some of the actors already are mature and they can contribute to the understanding of open data and to the incentivisation towards initial participation.

One can argue that this potential integration process is made easier to monitor and handle if the Open Governance Maturity Matrix is used as a city-wide standard framework. Then the actors of the adjoining system have the same approach to maturity measuring and understanding. Their mindsets will simply be easier to align. And one can be sure that if the two projects find themselves in maturity stage 7 or 8 then the integrated system will easily mature because all the actors understand the necessity for proper incentivisation and holistic thinking.

6.2.2 Uncertainties regarding time and funding

One thing that might prevent public and private actors to participate in an open data collaboration based on the Open Governance Maturity Matrix is the lack of any time specification. The actors do not know when a time investment starts to pay back and that can be a potential deal breaker for any collaboration. Our maturity matrix addresses the creation of system-wide incentives to keep on participating but it is not specifically dealing with the issue of creating a time horizon.

We have indicated how the willingness from the public sector to create a funding platform is crucial for the success of the project until it becomes a proper sustainable ecosystem. With great time uncertainties the decision-makers do not know for how long such funding should occur. Money has to come from somewhere for the project to get started.

Even though we are not addressing the specific issues of time and funding we ensure that short-term wins and value propositions are created and formulated across the whole ecosystem. These short-term wins include generation of fast economic profit. And so, it is equally important for both private and public actors to consider how to formulate and align incentives that counterbalance the time uncertainties. The plausible result is short-term direct or indirect economic profit.

Søren Møller Jensen is explaining how Copenhagen Connecting is in trouble because "the municipality is reluctant when it comes to allocating a right funding for it [even though] there are so many fine ideas within that project" (Appendix A.3, 01:02:28). We have tried to incorporate mechanisms that can handle the reluctance of the public sector to spend a lot of money on large open data initiatives, where incentive alignment and the creation of tangible wins are the most important factors. The idea is that built-in institutional design in the collaboration framework automatically takes care of mitigating risks and uncertainties by aligning mindsets and gradually constituting new norms, policies, and behaviour. But there might still be an initial reluctance towards initiating such initiatives in the first place and in that case the maturing process will probably never get started.

6.2.3 Privacy concerns and legal barriers

Privacy is a very important issue especially regarding Open Government and opening up PSI about citizens. Søren Kvist says that

"[i]t's very important to make a clear distinction between open data and more privacy-related data. If we look at energy data, what we can do is to aggregate some of this data on the building level, and anonymise this data so we will be able to make some of it available as open data, but it should never ever be possible to relate that data with an individual person or individual household."

The Open Governance Maturity Matrix does not specifically address such privacy concerns. It might be considered as a meta-model for handling privacy issues because it establishes an equal forum for actors to discuss terms of privacy. In fact privacy issues coexist along with policy issues and Henrik Korsgaard explains how privacy and legislation are related:

"So one can't just talk about open data without visiting the policy side: who owns the data? what are the legal requirements? who can use it? what about privacy issues? Do you know the Danish digitization board that ensures privacy for instance? In Denmark the tax body can't combine information across systems, because that's illegal. But when you make the data open everybody can do it. How do you handle that?" (Appendix A.4, 29:48)

6.2.4 Concerns regarding proper institutional design

Before we mentioned how institutional design has been build into the Open Governance Maturity Matrix and we have argued that that ensures the sustainability of the ecosystem by creating new collaboration and sharing norms and policies. We see an issue in building in such relatively unquantifiable and unmeasurable factors into a normative model. There might be subjective opinions to when policies and norms fit to a certain project and it is difficult to measure whether policies and norms are flexible enough to accommodate changing requirements and needs.

In fact, policy development normally requires a lot of time and it is fully dependent on rigid political and legislative institutions. The idea behind the Open Governance Maturity Matrix is, however, that if it is followed incrementally, incentives to policy development will be fostered as a direct consequence of actors' increasing maturity and willingness to opening up and break down business silos. One can imagine that other institutional frameworks can be used as parts of the maturity model to reach a new maturity stage; for example specific policy development frameworks that can be use for going through maturity stages 5-7. In that case the Open Governance Maturity Matrix becomes a normative meta-framework/model.

6.2.5 Involvement of the whole quadruple helix - what about the citizens and academia?

In our explanation of the research background in section 1.1 we outlined how long term success of smart city initiatives is dependent on mindset alignment among all ecosystem actors. Until now we have only described the role of the public and the private sectors in this ecosystem, but of course academia and citizens are important players as well – the question is to which extent they are important in a maturing process.

We have consciously looked away from the interests of the citizens even though all the interviewees emphasize the importance of legitimizing new innovations and investments through the citizens. This was mainly because Søren Møller Jensen emphasizes that citizens involvement "cannot replace the visions of private and public actors but can be seen as an important facilitator" (Jensen, 2014). We have not specifically incorporated this facilitation process in our maturity matrix as it is just a way to reach maturity stage 1 of formulating a clear vision. If the citizens are facilitating the formulation of this vision it might be easier to legitimize the investments politically. Furthermore, citizen engagement is hard to tackle because they are so hard to identify and as Adrian Ulisse says, "citizens are generally lazy [and] expect things to happen for [them]" (Appendix A.2, 26:50). Henrik Korsgaard and Lasse S. Vestergaard have similar points. And so, it seems like the citizens are a too complex matter to include in the maturing process. Therefore we have decided to not specifically address citizens in our maturity matrix. That does not prevent specific citizens or export groups to be considered as relevant for a certain project and they can of course be included in the maturing process if necessary.

Academia can of course also be involved as a relevant actor in the project and participate in the maturing process. They can also just function as facilitators of knowledge and expertise and by that help increasing the collective mindset maturity. Academia is typically an actor within the cluster organisations.

6.3 The Final Thoughts – what we have learned

In this section we want to discuss our findings and the justification of eventual grounded theory. And so this is a kind of wrap-up summary of the most important points of this research which will include an evaluation of our theoretical and methodological approach. This will lead to a discussion regarding the extent to which we have answered to our research question. We will point to future research that can validate our findings and grounded theory and this will also function as an evaluation of the whole research project.

6.3.1 Grounded theory

We started out with the initial presumptions (1) that open data has a democratizing effect that can increase social capital and by that allows collective decision-making and holistic smart city solutions that enable sustainable development, and (2) that open public and private data can lead to cross-sector innovation and function an enabler of other smart city innovations/solutions. That lead to the formulation of the main research question of how a conceptual maturity model for assessing and guiding open data collaboration. We also committed ourselves to investigate the sustainability enabling effects of open data collaboration and the most important incentive structures for participating in such a collaboration. This was the point of departure of our grounded theory approach.

By means of a structured empirical approach we collected data that gradually shaped our knowledge and it was condensed and held up against the theory presented in chapter 3. That led to grounded theories that is well founded in theory and the scope of practice that we included in this research. It is our assumption that our primary data represent a significance of the prevailing perceptions of the subject matter.

First of all we have depicted that open data maturity can be put into five different categories (figure 5.1). Such a categorization can function as a useful taxonomy when dealing with maturity in a complex system such as a city. We have found it useful to in the development and communication of a normative maturity model.

Furthermore, we have shown that sustainability in a smart city context is not only about addressing environmental issues – the concept easily becomes a cliché if it is not carefully treated. The concept of sustainable development (Hilty and Aebischer, 2015) inherently requires balancing the social, economic, and environmental issues and it is the primary task of a smart city to strive for it. We have shown that sustainable development cannot be achieved on a city level without a certain amount of collective maturity among relevant actors so they understand the need for holistic thinking and business silos breakdown that can lead to synergy creation and system agility. Sufficient incentives for actors to break down their business silos can only be created if the complexity of the city is broken down to tangible subsystems/projects where concrete short-term wins can be formulated and the initial purpose of the project is easy to understand. Therefore we argue that

Theorem 1: Sustainability (economic, environmental, and social) and sustainable development must be fostered from a bottom-up approach in a complex system such as a city.

Sustainability is not a goal in itself but covers the ability of the system actors to take collective action towards an ideal optimum. Our research depicts the inevitable wicked problems in a society: what might be beneficial for one actors might harm other actors; what might be beneficial for the environment might harm business opportunities and welfare. Sustainability is a concept that has to be aligned across all system actors to minimize these rebound effects. Our research shows that the only way to do that is to break down the complex system into subsystems around concrete projects; here sustainability can be automatically fostered because a holistic mindset can be developed and incentives can be created for breaking down business silos. We have showed that open data is a means to achieve this bottom-up sustainability.

Therefore we can define a smart city as below:

Theorem 2: A smart city is a complex purposive system consisting of ideal-seeking subsystems that are in a continuous process of evolving and integrating with other subsystems and in which actors are in a continuous process of breaking down business silos.

The result of our research is a normative model for achieving this kind of smart city and the concept of open data is a means to collectively break down business silos and enable sustainability by making rebound effects quantifiable. At the same time open data is a tool for sustainability enabling smart city solutions because it allows actors to share information and create synergies that inherently balance all the areas of sustainability.

6.3.2 Answers to our research question

Let us recall the exact formulation of our research question and subquestions:

How can we make a conceptual maturity model for assessing open data maturity of a smart city ecosystem, which normatively can function as a guideline for relevant actors?

- Subquestion 1: How can open data be used as a sustainability-enabler in the context of smart cities?
- **Subquestion 2:** What are the most important incentive structures for attracting support for such a model among smart city actors?

The primary answer to our main research question is that we have been able to make such a model by means of using a grounded theory methodology that allowed us to combine our prior knowledge with secondary theoretical data and primary empirical data. This has revealed that there are many different categories of open data maturity and a matrix model can work as an assessment tool and provide normative guidelines for collective action. The process has enabled us to create a conceptual maturity model, which we want to call the Open Governance Maturity Matrix because it reflects that a successful open data approach to a smart city initiative is only reached in an open governance environment.

Our maturity matrix can assess the maturity stage of a smart city project that is based on open data. At the same time it provides normative guidelines towards increasing the maturity of the project. Therefore we argue that we have successfully have answered our main research question. The maturity matrix is verified through the usage of a grounded theory methodology, but it is not validated and therefore it can only be considered conceptual. In other words: we have used a *valid* methodology to build the maturity model, and so we know that we have *built the model right*. We have not ensured that we have *built the right model*. We have some ideas for the validation of the model which will be presented in the coming subsection 6.3.3.

Regarding subquestion 1, we have induced that if open data is used to break down business silos and to create cross-silo synergies it can function as a sustainability enabler. Sustainability is reached if smart city initiatives initiate in concrete idealseeking subsystems where collective open data maturity can be quantified and increased. Open data can be used to enable sustainability (1) directly by exploiting existing resources more efficiently by sharing them and (2) indirectly by using it as a means to increase the maturity of actors' collective mindsets and aligning visions that balance economic, social, and environmental sustainability and by that minimize eventual rebound effects.

Incentive structures have to be in place for attracting actors to participate in such a collective action. We have found that the most important incentives for participation is that actors can formulate their own requirements for short-term wins that can be built in to the project from the beginning. Short-term wins are necessary for reaching long-term goals. Another important incentive for participation is to proper understanding what open data is and its potential value. Therefore structures for these types of incentivisation have to be built into a normative model like ours.

During the maturing process more incentives for participation and collaboration will emerge as business silos are gradually broken down and valuable cross-silo synergies appear. Thereby we have also answered subquestion 2.

6.3.3 Ideas for future research

As previously mentioned, we have not tested and validated the Open Governance Maturity Matrix as part of this research. We will now discuss how such a validation process can look like in the future. Furthermore, we will point to future research that can make the argumentation behind the Open Governance Maturity Matrix stronger and that can lead to a more comprehensive model.

A typical theory testing/validation process can happen through case studies based on deduction (Saunders et al., 2009; Kuada, 2012). Such deduction studies would have to opportunity to reveal in what kinds of contexts the Open Governance Maturity Matrix can be used and what changes are needed for it to fit to certain contexts.

Deductive case studies can show if our maturity matrix only fits to a Danish/European context in its current form, which is likely to be the case because of our choice of interviewees and scope. Institutional design and business ecosystems construction might require other design techniques and mechanisms due to different political systems, cultures, and mindsets. And so, deductive studies will increasingly refine the maturity matrix and define its limitations and usability and by that make it more valid in certain contexts.

An obvious place to start can be the case of Copenhagen Connecting where a study will reveal if our maturity matrix is acceptable by the steering committee and the stakeholders and if steps or questions are missing in the normative maturing process. It will reveal if the visualisation of the maturity steps and conditions are sufficient for incentive creation and as a basis for collaboration. There are indeed many parameters which can be tested to strengthen efficacy of the maturity matrix and make it more valid.

Theorem 1 and 2 are induced from our findings and provide workable definitions of sustainability and smart cities that can contribute to the successful implementation of the Open Governance Maturity Matrix. These theorems are falsifiable in that they can be tested and refined. Reformulation of these theorems is causal to rethinking the maturity matrix and vice versa. According to Popper (1963) falsifiability is key to genuine theory because

"[c]onfirming evidence should not count except when it is the result of a genuine test of the theory; and this means that it can be presented as a serious but unsuccessful attempt to falsify the theory." (Popper, 1963, p. 35)

Therefore, future research studies can set up a predefined series of attempts to falsify the Open Governance Maturity Matrix. The results of such studies is a validation process (Wallis, 2008).

Chapter 7 Conclusion

We conducted this research because we identified a potential beneficial contribution to the current discourses of smart cities and open data. The field of Enterprise Architecture (EA) has been using the concept of organisational maturity to quantify and measure the level of an organisation's ability to think and act holistically and thereby aligning its strategy with its business and technology. EA maturity models also provide normative guidelines for increasing the maturity. We wanted to investigate the possibilities for a smart city to adopt maturity as a tool for normative development and improvement and we chose to focus specifically on open data initiatives to narrow our scope. The choice of open data was mainly due to two presumptions: (1) that open data has a potentially democratising effect which can bring all smart city actors together to allow collective decisions and development of holistic smart city solutions, and (2) that opening up private and public data in a collectively decided way can lead to cross sector innovation and function as an enabler of other smart city innovations. We argued that these two presumptions show that open data is a means to achieve sustainable development and balance the three pillars of sustainability. Therefore, our main research question addresses how to make a conceptual maturity model for assessing open data maturity of a smart city ecosystem, which normatively can function as a guideline for relevant actors. We also wanted to investigate (1) how open data can be used as a sustainability-enabler in the context of smart cities and (2) what the most important incentive structures are for attracting support for such a model among smart city actors.

We primarily based our research methodology on an inductive research approach with the aim to create new theory that answers the research question. We decided to follow a Straussian grounded theory approach that allowed us to collect empirical qualitative data and systematically create and develop our knowledge and bias of the subject matter in accordance to our critical realist epistemology. Secondary data about systems theory, ecosystems theory, institutional theory, and open innovation theory was used to base our knowledge creation on well-founded research. And so, these theories form the underlying basis of research and subsequent findings.

We chose to base our primary data on seven semi-structured interviews with experts in the fields of smart cities, open data, and sustainability.

Our analysis consisted of a coding of the primary data which was elaborated on by means of the secondary data. It yielded important parameters to be included in a conceptual maturity model concerning open data in smart cities and it confirmed the two open data presumptions thereby verifying the basis of our research. It enabled us to systematically identify dependencies and contingency approaches to open data maturity in a smart city context. The primary result of this research is a conceptual open governance maturity matrix (table 5.6), which can both assess open data maturity of a smart city system and provide normative guidelines for increasing the maturity. A platform for open governance is important because it allows equal rights to participation and incentivises collective decision-making. Furthermore, open governance is a means to catalyse a collective and holistic maturing process where actors increasingly understand how to incentivise other actors and the fact that the longterm success of the project is more important than the individual short-term success. Thereby we have answered our main research question.

We have answered subquestion 1 by inducing that if open data is used to break down business silos and to create cross-silo synergies it can function as a sustainability enabler: Sustainability is reached if smart city initiatives initiate in concrete ideal-seeking subsystems where collective open data maturity can be quantified and increased. Open data can be used to enable sustainability (1) directly by exploiting existing resources more efficiently by sharing them and (2) indirectly by using it as a means to increase the maturity of actors' collective mindsets and aligning visions that balance economic, social, and environmental sustainability and by that minimize eventual rebound effects.

We have answered subquestion 2 by inducing that the most important incentives for participation is that actors can formulate their own requirements for short-term wins that can be built in to the project from the beginning. Short-term wins are necessary for reaching long-term goals. Another important incentive for participation is a proper understanding what open data is and its potential value.

Due to our choice of methodology and research approach we have been able to create grounded theory that support our primary findings. First of all we have addressed the importance of an accurate definition of open data maturity and we have sketched a taxonomy for open data maturity (table 5.1). Secondly, we have been able to contribute to the current smart city discourse by formulating the two theorems of how to approach the concept of sustainability in a complex system and a verified definition of the concept of smart city:

- **Theorem 1:** Sustainability (economic, environmental, and social) and sustainable development must be fostered from a bottom-up approach in a complex system such as a city.
- **Theorem 2:** A smart city is a complex purposive system consisting of ideal-seeking subsystems that are in a continuous process of evolving and integrating with other subsystems and in which actors are in a continuous process of breaking down business silos.

This research is a contribution to the ongoing smart city debate and shows how we can benefit from transforming the narratives of smart cities, open data, and sustainability into more well-defined and yet still abstract concepts when dealing with complex systems. Our research shows that it is possible to create a conceptual model for systematically handling the wicked problems within a complex system such as a city. It shows how to break down the system into smaller quantifiable subsystems and we have accounted for its verifiability. The Open Governance Maturity Matrix combines the importance of equal inclusion of actors, well-defined maturity subjects, and stages depicting the level of maturity into three interdependent dimensions that together provide guidelines for normative action. Even though we have not checked the validity of the maturity matrix as part of this research, we have depicted that it is possible to simplify the complexity of smart cities and create normative guidelines for sustainable development and collective decision-making. As such, this is pioneer, state of the art research and we consider the outcome successful from a structuralist perspective where we have made a tool for guiding social phenomena towards the creation of mutually beneficial interrelations.

Chapter 8

Bibliography

- Ackoff, R. L. (1971). Towards a system of systems concepts. *Management Science*, 17(11):661–671.
- Akçomak, I. S. and ter Weel, B. (2008). Social capital, innovation and growth: evidence from Europe. IZA Discussion Papers, No. 3341.
- Auer, S., Bizer, C., Kobilarov, G., Lehmann, J., Cyganiak, R., and Ives, Z. (2007). Dbpedia: A nucleus for a web of open data. Springer.
- Bakıcı, T., Almirall, E., and Wareham, J. (2013). A Smart City Initiative: the Case of Barcelona. *Journal of the Knowledge Economy*, 4(2):135–148.
- Bason, C. (2010). Leading Public Sector Innovation: Co-creating for a better society. Policy Press., Queen's Avenue, Bristol BS8 1SD, UK, 1st edition.
- Bates, J. (2012). "This is what modern deregulation looks like": Co-optation and contestation in the shaping of the UK's Open Government Data Initiative. *The Journal of Community Informatics*, 8(2).
- Berg, M. V. D. and Steenbergen, M. V. (2007). Building an Enterprise Architecture Practice: Tools, Tips, Best Practices, Ready-to-Use Insights, chapter 6. Priorities in the Architectural Process, pages 81–94;151–183. Springer.
- Berners-Lee, T., Bizer, C., and Heath, T. (2009). Linked Data The Story So Far. International Journal on Semantic Web and Information Systems, 5(3):1–22.
- Blackburn, S. (2008). Oxford Dictionary of Philosophy, chapter "Structuralism". Oxford University Press, 2nd edition.
- Calhoun, C. (2002). Dictionary of the Social Sciences, chapter "ecosystem". Oxford University Press, 1st edition.
- Cerrillo-i-Martínez, A. (2012). Fundamental interests and open data for re-use. *In*ternational Journal of Law and Information Technology, 20(3):203–222.
- Chesbrough, H. (2005). Open Innovation: A new Paradigm for Understanding Industrial Innovation. In Henry Chesbrough, Wim Vanhaverbeke, J. W., editor, *Open Innovation: Researching a New Paradigm*. University of California, October edition.

- Chesbrough, H. W. (2003). The Era of Open Innovation. *MITSloan Management Review*, 44:35–41.
- Chourabi, H., Nam, T., Walker, S., Gil-Garcia, J., Mellouli, S., Nahon, K., Pardo, T., and Scholl, H. J. (2012). Understanding Smart Cities: An Integrative Framework. In System Science (HICSS), 2012 45th Hawaii International Conference on System Sciences, pages 2289–2297.
- Clarke, R. Y. (2013a). Smart cities and the internet of everything: The foundation for delivering next-generation citizen services. Alexandria, VA, Tech. Rep.
- Clarke, R. Y. (2013b). Smart Cities and the Internet of Everything: The Foundation for Delivering Next-Generation Citizen Services. Sponsored by: Cisco. IDC Government Insights. White Paper.
- Colman, A. M. (2014). Oxford Dictionary of Psychology, chapter "Normative". Oxford University Press, 3rd edition.
- Corbin, J. and Strauss, A. (1994). Grounded theory methodology. *Handbook of qualitative research*, pages 273–285.
- Dameri, R. P. and Rosenthal-Sabroux, C. (2014). Smart City: How to Create Public and Economic Value with High Technology in Urban Space. Springer.
- Davies, T. G. and Bawa, Z. A. (2012). The Promises and Perils of Open Government Data (OGD). The Journal of Community Informatics, 8(2).
- Dietrich, D., Gray, J., McNamara, T., Poikola, A., Pollock, R., Tait, J., and Zijlstra, T. (2012). Open Data Handbook Documentation. Technical report, Open Knowledge Foundation.
- Douven, I. (2011). Abduction. In Zalta, E. N., editor, *The Stanford Encyclopedia of Philosophy*. Stanford University Center for the Study of Language and Information, spring 2011 edition.
- European Commission (2011). Open data An engine for innovation, growth and transparent governance. Communication from the commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions.
- European Commission (2013). Horizon 2020 Work Programme 2014 2015, chapter 5. Leadership in enabling and industrial technologies. European Commission Horizon 2020.
- European Parliament (2013). Directive 2003/98/EC of the European Parliament and of the Council on the re-use of public sector information. European Parliament.
- Finkbeiner, M., Schau, E. M., Lehmann, A., and Traverso, M. (2010). Towards Life Cycle Sustainability Assessment. Sustainability, 2:3309–3322.
- Fioretti, M. (2010). Open Data, Open Society a research project about openness of public data in EU local administration. Scuola Superiore Sant'Anna, Pisa. For the Laboratory of Economics and Management of Scuola Superiore Sant'Anna, Pisa.

- Fransman, M. (2010). The new ICT ecosystem: Implications for policy and regulation. Cambridge University Press.
- Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanovic, N., and Meijers, E. (2007). Smart cities-Ranking of European medium-sized cities. Technical report, Vienna University of Technology.
- Glaser, B. and Strauss, A. (1967). The discovery of grounded theory: Strategies for qualitative research. Aldine, Chicago, IL.
- Goodland, R. (2002). Sustainability: human, social, economic and environmental. Encyclopedia of Global Environmental Change. John Wiley & Sons.
- Gurin, J. (2014). Open Data Now: The Secret to Hot Startups, Smart Investing, Savvy Marketing, and Fast Innovation. McGraw Hill Education.
- Gurstein, M. (2011). Open data: Empowering the empowered or effective data use for everyone? *First Monday*, 16(2).
- Haaf, W. T., Bikker, H., and Adriaanse, D. (2002). Fundamentals of Business Engineering and Management, A systems approach to people and organisations, chapter 3, Introduction to the system approach, pages 49–81. Delft Academic Press.
- Hilty, L. M. and Aebischer, B. (2015). Ict for sustainability: An emerging research field. In *ICT Innovations for Sustainability*, pages 3–36. Springer.
- Hitachi (2013). Hitachi's Vision for Smart Cities Seeking the Optimal Balance Among People, Places, Prosperity, and the Planet. White Paper.
- Hofmann, M. and Beaumont, L. R. (2005). Content Networking: Architecture, Protocols, and Practice. Elsevier.
- Hollands, R. G. (2008). Will the real smart city please stand up? City: analysis of urban trends, culture, theory, policy action.
- Howard, A. (2012). *Data for the Public Good*. O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472, 1st edition.
- Huijboom, N. and den Broek, T. V. (2011). Open Data: an International Comparison of Strategies. *European Journal of ePractice*, 12.
- Iansiti, M. and Levien, R. (2004). Keystones and dominators: Framing operating and technology strategy in a business ecosystem. *Harvard Business School, Boston.*
- Intel IT Center (2012). Planning Guide: Getting Started with Hadoop. Steps IT Managers Can Take to Move Forward with Big Data Analytics.
- Janssen, K. (2011). The influence of the PSI directive on open government data: An overview of recent developments. Government Information Quarterly, 28:446—456.
- Janssen, K. (2012). Open Government Data and the Right to Information: Opportunities and Obstacles. *The Journal of Community Informatics*, 8(2).

- Jenkins, W. and Bauman, W. (2010). Berkshire Encyclopedia of Sustainability Volume 1: The Spirit of Sustainability.
- Jensen, S. M. (2014). Smart City En styrkeposition i Region Hovedstaden. København. Copenhagen Capacity - Samarbejde om Proaktiv Investeringsfremme (SPI).
- Jones, M. and Alony, I. (2011). Guiding the Use of Grounded Theory in Doctoral Studies An Example from the Australian Film Industry. *International Journal of Doctoral Studies*, 6:95–114.
- Jonkers, H., Burren, R., Arbab, F., Boer, F. D., Bonsangue, M., Bosma, H., Doest, H. T., Groenewegen, L., Scholten, J. G., and Hoppenbrouwers, S. (2003). Towards a language for coherent enterprise architecture descriptions. In *Enterprise Distributed Object Computing Conference*, 2003. Proceedings. Seventh IEEE International, pages 28–37. IEEE.
- Komninos, N., Pallot, M., and Schaffers, H. (2013). Special issue on smart cities and the future internet in europe. Journal of the knowledge economy, 4(2):119–134.
- Koppenjan, J. and Groenewegen, J. (2005). Institutional design for complex technological systems. Int. J. Technology, Policy and Management, 5(3):240–257.
- Korsgaard, H. and Brynskov, M. (2012). Prototyping a smart city. In International Workshop Digital Cities.
- Kuada, J. (2012). Research Methodology A Project Guide for University Students. Samfundslitteratur, 1 edition.
- Kvale, S. (2007). Doing Interviews. Sage Publications Ltd., London. ISBN: 978-0-7619-4977-0.
- Laitner, J. A. S. (2015). The Energy Efficiency Benefits and the Economic Imperative of ICT-Enabled Systems. In Hilty, L. and Aebischer, B., editors, *ICT Innovations* for Sustainability, volume 310 of Advances in Intelligent Systems and Computing, pages 37–48. Springer International Publishing, Switzerland.
- Lakomaa, E. and Kallberg, J. (2013). Open data as a foundation for innovation-the enabling effect of free public sector information for entrepreneurs. *IEEE Access*.
- Lee, J. H., Hancock, M. G., and Hu, M.-C. (2013). Towards an effective framework for building smart cities: Lessons from seoul and san francisco. *Technological Forecasting and Social Change*, pages xxx–xxx.
- Lee, S. M., Hwang, T., and Choi, D. (2012). Open innovation in the public sector of leading countries. *Management Decision*, 50(1):147–162.
- Luhmann, N. (1982). The World Society as a Social System. International Journal of General Systems, 8(3):131–138.
- Malpas, J. (2014). Hans-Georg Gadamer. In Zalta, E. N., editor, *The Stanford Encyclopedia of Philosophy*. Stanford University Center for the Study of Language and Information, winter 2014 edition.

- Manville, C., Cochrane, G., Cave, J., Millard, J., Pederson, J. K., Thaarup, R. K., Liebe, A., Wissner, M., Massnik, R., and Kotterink, B. (2014). *Mapping Smart Cities in the EU*. European Union.
- Mattern, F., Staake, T., and Weiss, M. (2010). ICT for Green: How Computers Can Help Us to Conserve Energy. In *Proceedings of the 1st International Conference* on *Energy-Efficient Computing and Networking*, e-Energy '10, pages 1–10, New York, NY, USA. ACM.
- Moore, J. F. (1993). Predators and Prey: A New Ecology of Competition. Harvard Business Review, 71(3):75–86.
- Mulligan, C. (2008). Open API standardisation for the NGN platform. In Innovations in NGN: Future Network and Services, 2008. K-INGN 2008. First ITU-T Kaleidoscope Academic Conference, pages 25–32. IEEE.
- Nam, T. and 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: Digital Government Innovation in Challenging Times, pages 282–291. ACM.
- Neirotti, P., Marco, A. D., Cagliano, A. C., Mangano, G., and Scorrano, F. (2014). Current trends in smart city initiatives: Some stylised facts. *Cities*, 38:25–36.
- Newman, P. and Jennings, I. (2008). *Cities as sustainable ecosystems: principles and practices.* Island Press.
- OECD (2011). Government at a Glance 2011.
- Paskaleva, K. A. (2011). The smart city: A nexus for open innovation? Intelligent Buildings International.
- Popper, K. R. (1963). Science as falsification. *Conjectures and refutations*, pages 33–39.
- Putnam, R. (2000). Bowling Alone: The Collapse and Revival of American Community. Simon and Schuster, New York.
- Rittel, H. W. J. and Webber, M. M. (1973). Dilemmas in a general theory of planning. *Policy Sciences*, 4(2):155–169. doi:10.1007/BF01405730.
- Robinson, D., Yu, H., Zeller, W. P., and Felten, E. W. (2008). Government data and the invisible hand. *Yale JL & Tech.*, 11:159.
- Ross, J. W., Weill, P., and Robertson, D. C. (2006). *Enterprise architecture as strategy: Creating a foundation for business execution*, chapter 4. Harvard Business Press.
- Sagiroglu, S. and Sinanc, D. (2013). Big data: A review. In Collaboration Technologies and Systems (CTS), 2013 International Conference on, pages 42–47. IEEE.
- Saunders, M., Lewis, P., and Thornhill, A. (2009). Research Methods for Business Students. Pearson Education Limited, Edinburgh Gate, Harlow, Essex CM20 2JE, England, 5th edition. ISBN: 978-0-273-71686-0.

- Schaffers, H., Komninos, N., and Pallot, M. (2012). Smart Cities as Innovation Ecosystems Sustained by the Future Internet. Fireball White Paper.
- Schaffers, H., Komninos, N., Pallot, M., Trousse, B., Nilsson, M., and Oliveira, A. (2011). Smart Cities and the Future Internet: Towards Cooperation Frameworks for Open Innovation. In Domingue, J., Galis, A., Gavras, A., Zahariadis, T., Lambert, D., Cleary, F., Daras, P., Krco, S., Müller, H., Li, M.-S., Schaffers, H., Lotz, V., Alvarez, F., Stiller, B., Karnouskos, S., Avessta, S., and Nilsson, M., editors, *The Future Internet*, volume 6656 of *Lecture Notes in Computer Science*, pages 431–446. Springer Berlin Heidelberg.
- Schultz, S. (2013a). Cities the real climate heroes? Copenhagen Cleantech Journal, 5:4–9.
- Schultz, S. (2013b). Is the climate change battle being lost or won in cities? Copenhagen Cleantech Journal, 5:4–9.
- Tauberer, J. (2014). Open Government Data, chapter A Maturity Model for Prioritizing Open Government Data. Joshua Tauberer, 2nd edition.
- The Danish Government (2013). OPen Government- National Action Plan 2013-2014.
- The Danish Government / Local Government Denmark (2012). Good basic data for everyone a driver for growth and efficiency. The Danish Government. The eGovernment Strategy 2011-2015.
- The UK Cabinet Office (2012). Open Data White Paper Unleashing the Potential. Presented to Parliament by the Minister of State for the Cabinet Office and Paymaster General by Command of Her Majesty.
- Thorning-Schmidt, H. and Østergaard, M. (2014). En bæredygtig udvikling er det eneste, der holder. *Politiken*, Debat:5–6. 13th of October.
- Toppeta, D. (2010). The smart city vision: how innovation and ict can build smart, "livable", sustainable cities. *The Innovation Knowledge Foundation*.
- Wallis, S. E. (2008). Validation of theory: Exploring and reframing Popper's worlds. Integral Review, 4(2):71–91.
- Wittke, V. and Hanekop, H. (2011). New Forms of Collaborative Innovation and Production on the Internet. Universitatsverlag Gottingen, Gottingen.
- Yu, H. and Robinson, D. G. (2012). The New Ambiguity of "Open Government". 59 UCLA L. Rev. Disc. 178, pages 180–208.

Appendix A Transcriptions of Interviews

A.1 Kristoffer Hvidsteen

(02:34) Kristoffer, is it okay if we record this interview? Sure, as long as, if you are going to publish any of this I would like to see the exerts. If you use any quotes then please do involve me and give me a chance to look at it. If it's just for your thesis and it's not published, then it doesn't matter, don't think about it. But if it's going into some kind of publication or a wider audience then I'm obliged to involve our communications people and have an approval.

(03:15) Yes that makes sense. For now we are only using this for the master thesis and we will contact you if anything develops. Sure. And to introduce myself, I'm Sustainability Lead in Denmark for Accenture, which means I'm helping our guys to think through on how to act in the sustainability phase. Yes that's pretty much my job here. We are a global company, I don't know if you know us but we are a 100.000 employee company operating around the globe. We are listed on the New York stock exchange and that sort of things. And we are a company doing, you know... I'm in business strategy, so we stand on three legs so to speak: we have Accenture Strategy, Accenture Operations, and Accenture Technology. So part of the business is to provide advise around strategy and part of the business is about outsourcing, and then lastly is about technology systems for companies and clients.

(04:35) Where does the sustainability come in? The way it comes in is, from an emerging point of view in Accenture, that any strategy has to consider sustainability. If you don't think about aspects beyond the single bottom-line you are at great risk, and in some industries really great risk of overlooking important aspects of your role as a company, your role as an organization, which will limit your ability to create value for your clients, especially in the medium and longer term matters, to be able to function properly and effectively. So in that sense it's an emerging scope for many companies and organizations to start thinking about this in a holistic and a systematic manner.

(06:04) So sustainability from your point of view can be viewed just as being holistic? It's not just about environmental issues and treating them in the proper manner and so on. It's thinking in a long-term way, or what?

(06:22) If you talk about the definition of sustainability then I would say it comes to what your role in society is. What is your role in the world as an organization. What is your basis for being around? Why should we be able to have resources? Why should we be a customer of yours? Why should you be functioning? And if you can't answer that question then you have a challenge in the short, medium, or longterm. So basically it's about understanding how you are contributing to the world. Of course after having answered then you need to think about how you can have a business model that supports that. What does your operating model look like? But if you can't fundamentally answer the question and you want to be high flying, you can't connect it to your mission to a human right. As a codification of aspirations of people around the world, then I think you have a little bit of a challenge in term of motivating your employees, in terms of having the trust and the benevolence of politicians, of our society as a whole. So then my definition would be that you need to understand what your role in society is. Is it providing IT, is it providing access to food, is it to provide clothing or what kind of functionality or usability do you provide to the world.

(08:10) And you know, the reason we think you would be very interesting is because as we see it you are representing the interests of the private sector. And so you also represent an important actor in the smart city discourse. We are doing this master thesis about how to harvest the value of opening up data between sectors to be able to harvest synergies and so on. We contacted you because you have been quoted in Søren Møller Jensen (2014) publication about smart cities, and what is your relation to smart cities at all, why are you interested in smart cities? As a private person, or as a representative of Accenture or the private sector. (09:20) Yes. Not as a private person. I think it's a little bit of a tricky question because I think those two things are actually closely related. When we talk about smart cities point of view, if you want to boil it down, is that it's not technology first. I mean if you have to look at smart cities or intelligent cities, it's not about how you label it. It is about basically what user value you can provide to people living in the cities or to companies operating in the cities or organizations functioning in the cities. Smart city is about making life easier for companies, making life easier for people, making life easier for organizations. If you can't do that it's not smart and it's not desirable. And so, it's not really about the data, it's not really about the technology. It's about the ability or the imagination that you can use around it to, for example, make it easier for people to move around in the city, make it easier for a company to operate on a day-to-day basis. It could be more energy efficient for instance. But basically it's about having less paperwork to deal with or having their goods transported around in a more efficient way. And sure, we absolutely think that technology is a key enabler of this but in the end of the day it is about creating values for companies or for people. If you can't create new value for them then it doesn't matter - you can have all the technology in the world. And we see examples of this. You know, you find a new gadget and at least for a while you don't know what user value it has, but I mean there is a desirability for newness. But until it becomes something that provides value for people and for companies then it's not interesting and then it's not smart.

(11:30) Ok. So what is your interest in this from a sustainability point of view? Is that to sustain the current quality of life into the future? I think that the sustainability angle, if you will, is a narrative for some. It is a way to describe these things and to me it's about the fact that we live in a world of finite resources. Time is finite in the sense that each of our time here on the planet is finite. The amount of resources that we have is finite. And when you look at that situation you need to think about how you use those resources and the cost-effectiveness of the usage of those resources in terms of sustaining quality of life or providing value to companies and people. So our interest in this is that you have the ability today to be much smarter around the way we produce and consume. Especially in cities because you have an agglomeration of people in a city and companies and so on. There are a lot of barriers that you would face if you have these more disperse groups that would inhibit such an efficient way of operating. So basically in cities the notion is this: You can enable people to live a much higher quality life using much less resources than what is today. So spend less time, wasting less time in the city, wasting less product material. Not at the cost of convenience, on the contrary... let me give you an example of that: Owning a drilling machine. If you need to hang stuff on your wall, you need a drilling machine to do that; you need to make the holes and the thing is that most of us, if not all of us, we don't really care about that drilling machine. Actually owning the drilling machine is hassle - you need to store somewhere, you need to maintain it, you need to charge the batteries, and you need the drill. It's a lot of hassle. And actually every one of us owning a drilling machine, that's a lot of drilling machines. And when we look at the usage of drilling machines it's about 8 minutes of average across the whole lifespan of the drilling machine. 8 minutes. And if you think about the concentration of materials and products that goes into a drilling machine it is kind of insane. But it has been the only way to do it without the technology enablement we have today. It has been the only way you can be able to consume holes, i mean, if you wanted holes in the walls you needed to buy a machine. There was no other alternative. Of course you could ask a carpenter to come and do it for you for a quite high rate, but those were the only two options. I read this weekend that in Göteborg you have a local retailer who is offering you to just come by and rent it for free. In Denmark you have www.jepti.dk who is allowing P2P sharing of drilling machines. And what you are seeing is that technology is enabling a smoothing of the consumption. It's not a binary thing where you either buy it or not buy it. You can actually borrow it, you can lease it, you can have somebody come and do it for you. And in that sense you get a smooth and much more linear way of consuming stuff, which results in that i get rid of my drilling machine in my house. I don't need to care about a drilling machine any more. And I can still get the consumption of holes, but at a lower cost. It's about high quality of life and less resources at less costs, so it's win-win if you will.

(16:10) It sound like exploiting the existing resources in a more efficient manner by means of opening up information across people and sectors? Yeah Yeah. Basically what's behind this is that you are able to... Technology enables you to understand who has got a need for something right now. In old days you could borrow from a friend or a neighbour, but now you have extended that to be everybody in your neighbourhood. The platform are enabling you to have a much wider reach so the opening up of data, which essentially here means: I have a certain

demand, and that demand in the old days could only be satisfied in a very crued and inaccurate manner. Today my demands are... If you have good data capability and analytic capability you are able to understand the consumption much much better and meet those demands much more accurately. So opening up the data is one part of it but that just becomes a cloud of data. We need to be able to understand and contextualize it for it to have value, so there are a lot of challenges around it. But it's possible. We see it in some sectors and it's just... Just commenting on what you said that it's about efficiency - it's not just about efficiency. Actually it's a game changer in the sense that what you have seen over the years... Drilling machine companies have started to produce crap, sorry for my language. They produce machine that last maybe 30 minutes of use, so to be cost effective and competitive, they started producing drilling machines that are really only meant to not being used in a sense. What happens now when we have this change of dynamics in the industry is that you will start seeing a change in the design of the products. The products will be designed much more to be re-manufactured and to be able to repair them. Something that is almost forgotten today is that you can actually repair stuff. When you are able to exploit the assets - the drilling machine or the car, etc. - much better, the the incentive structures change. Now you want to build a drilling machine that can last and actually drill for hours and hours. Go back to the seventies when they built the dishwasher that could last years and years and years, right? Today you see for example printers that are set to expire to keep the product... So it's not just about being more efficient, it is about changing the dynamics and the incentive structures. And yes, data absolutely is a prerequisite. It's not a sufficient condition, but it's a necessary condition.

(19:22) What is needed to make this ecosystem work? Because we have a lot of technology now, and we have a lot of possibilities with the data. But there is something which prevents it from being deployed in reality. (19:43) I think we are at the edge of this exploding in a broad fashion. There is a lot of smart, young people sitting around who put out a company like www.leapcraft.dk for example. They are sitting around, tinkering with different technologies, tinkering with different data streams and finding new ways to organize the way we operate and function. I would say yes, we haven't seen it explode completely yet, but it's something that's going to come. And the thing is, that propagating the data becomes much more easy. The cost of sensors is going down dramatically. I think we've seen only the beginning of it. And the reason why the actual implementation is lacking far behind our imagination, which is I guess what you are saying and other says, is the fact that when we talk to traditional companies that are sort of steeped in a linear model of producing and enabling consumption then they are set in legacy systems, in old SAP systems. They simply have an incredibly hard time at managing data. I mean, they are not a digital company first, that's an afterthought. And they spent millions and millions on putting in place, systems in the 80's and 90's and onwards that are not build for being smart around. They have a hard time even issuing an invoice that is a reflection of the actual consumption that they have. So in a sense the traditional companies that could maybe scale this fast they are at the outset when it comes to data. They have huge challenges. They see it happening, but when they look in their systems, when they look in data flows they simply are not able to open them up in a sense and be smart.

(22:15) How do you think you can create strong enough incentive structures for these traditional companies to participate in this smart development?

(22:27) To be honest, I'm not sure at all if any of these traditional companies are on it in ten years from now, unless they get in the game. Using technology, using data smart is going to be the dominating paradigm. It is simply more cost effective, it provides greater user value and lower costs. Simply a dominating paradigm. So you can pretend, like apps like Driver, Uber, and AirBnb, there is a politician and an established industry which tries to say: we are going to regulate them, we are not going to let them in, we put some barriers up. But the point is that they are going to prevail, it's just a question of if these traditional companies are going to get their minds together fast enough and be part of this new economy. I think this is going to happen and it will happen with or without them. I think, the way it looks right now is that it's going to be new emerging companies. When you look at like NeST Technologies what they have been able to achieve in a very shout time span, they don't have a legacy structure to fight with. They are a digital first company. So they don't have to carry all that weight around. The comparison is of course more subtle than that, but if you look at legacy carriers in the airline industry, like SAS, and you compare them to new carries like Norwegian and RyanAir, the legacy systems in SAS, the pension payments, the whole set-up in terms of their technology infrastructure and so on is just inhibiting them from being really efficient and being able to provide user value. Lot of the things they are paying and driving their costs does not provide any user value. It's simply something that is becoming redundant. When I look at these traditional companies, I'm concerned. What is their business going to look like 10 years from now? Because they will be weighed down by these things. And then there is something that I haven't mentioned vet: some of these things are at least at the surface value, you know, they are cannibalising their traditional business model. Or at least it would appear that way. So they feel that if they do a sharing platform then they will be able to move less product. And that is true. But the point is that, first of all, it's going to happen anyway. So you can either cannibalise it yourself or you can let somebody else do it. Secondly, the margins when it comes to providing services and accurate services are much much better than the margin that you will see by providing your product. In that sense our advise to any company is to get in this game, and do it fast. How you will do that is not an easy task but you need to absolutely think about it to stay relevant to your clients, consumer, or customers.

(26:12) Ok. That was a lot about how the private sector can be interested in being involved in all this. Where is the public sector in this? You also mentioned in the paper Jensen (2014) something about the relevance of the Big Data Platform that Copenhagen Cleantech Cluster has made a tender on. Where do you see the potential value in such a platform and what are the incentive structures regarding the collaboration between public and private parties? (26:53) I would first of all see it as two different things. There is the functioning of the public sector in itself, and there is government and policies and so on. As a Danish citizen and on the behalf of Denmark I'm concerned about our future competitiveness. If we don't, as a country, establish the right framework conditions for letting these innovative new start-ups have the best framework conditions world-wide - those are the designers of the future. We don't need to design any more chairs, we need to design a new app that provides value to people and that can be scaled across cities and countries, and if we don't provide that incubator situation in Denmark, then it's going to be driven out to San Francisco and wherever else where you have an agglomeration of talent and money and all the preconditions that you need. A policy initiative, like funding a platform where you propagate the data, I think is a fantastic good initiative to take. Because at the end of the day making good APIs that kids can play around with and dream of new algorithms, new ways of organizing our world and society, is absolutely what we need to get this layer of growth start moving. That said, what you are seeing companies like Leapcraft is doing, they say: "Wait a minute. You can't get the data out of the public sector, and if the private sector is struggling as well, you know what? we just propagate the data ourselves. People carrying cellphones will have their data propagated to us through their cellphones. We will put up sensors so we will get the data through them." There are many short-cuts coming up that sort of helps in bridging this gap. Because when you look at it, propagating the data, opening up the data from many of these institutions is a riddle with challenges that have to do with the structures of the public and the private sector. Both also in terms of the thinking around it, privacy issues, there is a long list of issues that they can come up with as to why they can really share the data. And maybe part of it is that we just can't compile the data in a sensible way. So there are ways around it. Somebody told me the other day about this little sensor you can put on your electricity measuring box at home. You have a kind of disc that is moving around and once a year you read the number on that. But if you put a small sensor that costs about 2 dollars that monitors that disc, then you actually have real time measurement of your electricity consumption. And that will cost you 2 dollars. So in the end of the day, if you look at how much you charge for providing smart meters and installing smart meters it is ridiculous. And by the time they have installed them they probably figure out that the technology and the way they have designed it does not provide the functionality that you need and so on and so forth. We need much more of these hacks. We need many more hacks in terms of finding smart ways of doing this. So I think it's good to have this big data projects, but I'm not sure that's going to be the way that's bringing us to an end, I'm not sure about that.

(30:50) It sounds like that the society could benefit from a mutual understanding between the public and the private sector of what value it can bring to open up. Don't you think there is some kind of idea in that, to be able to get to a mutual maturity between the public and the private sector towards understanding the open data perspectives? (31:30) When we talk to the private sector I think they understand it at least in business development and somewhere... There are people there who understand it, but there is a long way from understanding to being able to operationalise. In terms of the public sector I think they get it too, and I think they are struggling with tweaking their systems so that they can accommodate that. A good example of this is that we are more and more accustomed to and expecting that when you go talk to the public sector they understand this really well. If I have given my data to the public sector I expect them to be able to share that, so that if I meet whom ever else in the public sector they shouldn't be asking for my address again or whatever simple information that I have given them at one point of time. I think the general public is being conditioned and constantly accustomed to being met - our very specific desires being met very

directly. So when we step into the public sector office and they don't get it and we need to explain or spell it out, that creates disenchantment and you get the sense that they are bureaucratic and they are not getting in the game. So I think, from a consumer or client perspective the expectation is already there and it's going up and increasing all the time, and I think that both the public and the private sector understand this. But they have still not found a sort of great way of jumping over the legacy systems, if you will. They are kind of stuck in between building out the legacy systems and maybe jumping over the infrastructure to put on an overlay that is perhaps much more nimble but at the same time has the industrial strength that you also need from a public sector perspective at least. You need something really solid and so and so forth. And that's why it's daring to take it into sort of a digital age.

(33:55) It sounds like there is a lack of incentive structures to collaborate together whatsoever. And it also sound like.. hmm. It's just a thought, but do you think it's necessary for a smart city solution to be sustainable that the public sector is involved? (34:26) I think ideally, yes. In principle the public sector could play a big role, and I think we are testing that with this big data platform, but just having gone through the long process of talking to the city of Copenhagen and talking to various private sector players, you know what? It is not because they don't get and it's not because they don't want it, it is because when they sit there and look at their data it's just not there. I mean, it's not a question of them not wanting to necessarily share it. It's because they say: Can we share it? have our users authorized us to share it? Where do we even find it? How do we even get hold of the data we have got? I'm not sure it's lack of incentives and willingness, I think it's a matter of them just being unable to do it. (35:22) Simply too much complexity? Too much complexity yes. The data is not generated in a fashion that makes it readily available to distribute. And I think that it will probably be easier to generate new data streams, it will probably be cheaper to put sensors out there and start creating new data streams rather than relying on old structure to try and tweak them to provide data. I've heard of situations where you say: Just give us the data and it doesn't happen. And when you look at the cost of putting up sensors and so on, I think we are quickly transitioning into a situation whereby the cost of putting up data generating sensors is going to drop so much so why even bother about utilities? Why even bother with mobile telcos, at least the old ones? If we can just put up a sensor at a very low cost that generate all the data we need. I definitely think the incentive is there and I think we will see much much more of it.

(37:00) So what you say is that to be able to actually make this collaboration happen you possibly have to fresh start, to think of new platforms of innovations instead of using the old ones, which are just involved in too much rigidness and complexity? (37:35) You know what, I don't know. It is starting to look more and more like that to me. That the inability of legacy systems to have interoperability will cause a lock-in. They have to deliver the data in a shape and form that is enabling these kind of services and apps to be set up. It seems more and more like that with the cost of sensoring going down, that the inertia of this is so strong that we will just not wait for this. It's not going to be first-best solutions but we don't need first-best solutions because the ability to generate data that will then enable much better consumption and production, and superior consumption and production patterns, is happening today. And it's happening in quite a bit of speed. I mean, look at the smart meters for instance. That's a bit of old model solution in the sense that we need to change all the meters, we have to have new meters with much more capabilities. But they cost a fortune and they take years and years and years to develop. And in three years who knows what it's going to look like this market? With sensor technology coming up so fast, the market might have completely changed in three years. So before we even install the smart meters, I think they might even be obsolete.

(39:11) So that sounds like there should be kind of an ability to actually be agile and think agile in the different institutions? I think so. And I think, in terms of the public sector, there are certain services that they are obliged to provide and there are certain functionalities that they undertake. If they thought more like you do in San Francisco, I think they would learn and become much more efficient and much smarter around how they service their clients. And it would not necessarily be at the cost of the country of making sure that the process is following laws and regulations. It's built on legacy systems that are built by KMD and so on and it's very heavy stuff. One key role that the public sector could do that, I keep coming back to is the fact that: why don't I as a citizen own all my data? And shouldn't you enable me to go to my telco and say that I want all my data? And say that I want to give it to this app or to that app, because the functionality is great. I want that. I could go to my bank and say: It's my data I'm generating it, I want it. So please do an API that can provide it to this company because I want that functionality that I can get over here. I think that could maybe be appropriate. It could solve some of the privacy issues because it's driven by the data owner and it could also help to propel some of this transition to the economy because the audience think it's interesting and it's something they are willing to pay for. But I mean, there are different problems of the public and private sector to solve here.

(41:33) How do you think we can make concrete solutions for making both parties agile at the same time? what can be done in reality? (41:53) I don't there is so much we need. In terms of the private sector I think what we are seeing is that there is a lot of innovation going on already. I think that what we need to do there is to have the right regulations in place, that enable them to grow and develop even more. And some of that has to do with infrastructure and some of that has to do with providing funding for education and other traditional public sector things. But I'm not so concerned about the private sector, except from the competitive perspective of Denmark. I'm concerned for Denmark if we don't get more in the game because the private sector is moving as it is today. You see new apps coming up all the time, new companies start addressing this market. So the private sector is coming, the question is if it's going to be a Danish developer or does he have to make a developer in California develop it, which is happening today. If we want a growing layer of growth here, we need to do more in terms of having the enabling environment, having the right infrastructure. All the sort of incubation type of framework conditions that help. Because we don't have the venture capital funds as you do elsewhere but we have other stuff that will enable this, that will

un-necessitate entrepreneurs to take risk. From the public sector side, it's not just getting out of the way, but it's perhaps being a little more bold, putting this on the agenda of politicians in terms of saying that it's okay to fail. It's okay to take a little more chances to provide these innovative solutions. And I think, when it comes to regions like Region of Southern Denmark, you have some very innovative thing going around the hospital sector where they are looking into a lot of new technologies to help drive productivity and value creating for ... So I think there are things happening, but to scale it I think to be able to push this politically and say that we are willing to invest and to find new ways of servicing or filling our role as a service sector. And willingness to fail in this arena is vital.

(44:32) Don't you think that you, as a big private actor, have a responsibility or something to say here. You can actually help maturing the public sector and make the understand these service needs? (44:52) Yes we do and we would absolutely love to do that. And we are trying to do that on a daily basis. The thing is, there is lots of legacy in terms of failed investments form the public sector in these big systems, right. And a very limited success. So that's on the hand a really limiting factor. There are many examples of how badly things have gone and how much money has been invested and how badly the results have been. So on one hand you have that situation. On the other hand, and that causes an environment of risk aversion from the public sector side, you are really concerned with doing these traditional IT projects that leaves you to actually chose what appears to be very safe solutions, very incremental solutions. There is a sense of: we don't want to be too ambitious, if you will. We don't want to take too many chances, we want to limit our risk. And that means the scope of the projects have a certain nature. That means the ones that get invited to do the projects will be the likes of Accenture and only these huge companies, right? They want our guarantees that we will deliver the end product. Like CSC and so on. And that, in a sense, immediately cut of the innovative new layer of younger entrepreneurs that could perfectly well prototype really fast, try out a lot of different stuff, generate new data streams, and be very smart around these things. We would love to come in and provide IT strategic advise and scope the projects in a much bolder fashion and different fashion. But that's not the case today. The case today is that risk aversion is driving over-specification of projects, looking for incremental improvement rather than looking at some bold, innovative, transformational types of projects where you say: Let's forget what we've got today, let's go for something that is going to be really bold and might actually transform the way we provide our services. In that sense I think the public sector is missing out on a lot of opportunities when they don't have the vision to do that sort of things.

(47:43) It also sounds a little bit like a lack of responsibility from the public sector. I guess it's easier to write a specific contract regarding an incremental or well-defined specification from the public sector point of view. Instead of going into these more scalable, agile approaches where you don't know where to end. (48:10) I think it's more a question of risk aversion and the way the public sector is striving for zero mistakes. That's sort of the watermark you want to get to. So if you want to limit your risk for any damage as much as you possibly can then you go with a big company, you go with

an incremental change type project, you try to specify a lot of the variables. And then you have all the regulations around like tendering about competitive processes. And in the end of the day you are producing very uninteresting projects in a lot of ways, and projects that will not help them really make a change in the ways that they function, and then they are becoming more obsolete in people's lives in ways that are feeling more and more quint and peculiar. You wonder: why don't you know all these things? why do you ask me about this, I don't have any children, right? We are getting more and more used to getting instant answers to our specific questions, why does it take you a week? And why do you respond in e-mails? An that is driving their costs of and it's just an unhealthy situation whereby they are making themselves more and more obsolete and putting themselves in risk of discontent with the service level. But, again, to break that circle you need a completely different vision in terms of how you think about using technology and technology enablers. How can you think of service provision in a holistic way?

(50:24) So that's a kind of institutional development of the whole public institution as such? I think it requires some young people in the system to think about this in different terms, saying: Listen. The old way of doing business is dead, it's going out. We need to re-conceive the way we function and operate and let's try prototype and find different ways to make this work. Still they are talking about loosing the paper, but they are still using paper. So in that way there are lots of legacy systems that are weighing them down. I think what can help them is having a vision and the smart cities might be one way creating it and doing it. I don't think we have seen a great example yet of that exactly. We still remain to see how a city becomes completely smart to modern life.

(51:32) I have one question. You are saying that the public sector is not that mature enough to understand at the same level as the private sector in terms of innovation. (51:50) No. I think both the public and the private sector, both of the legacy players, I think many people understand this. But it's just that the structures in the public sector as such that, even though you understand it, it can be very hard to break down those barriers. So when you formulate a project and makes through to the different stakeholders and the different gatekeepers, if you come out with that crazy idea, if you at top have people sitting that are not used to using smartphones, that may not be tuned into these things, or if you somewhere along the system have somebody saying: That's great, but you know, if we are to innovate and we end up with a shit project that is going to cost us millions and we have nothing to show, then we are all getting fired. The minister is going to be upset, or the major is going to be upset. Let's play it safe. And then nobody is going to fire us, nobody is going to put us out of our job. There is a lot of playing safe and risk aversion explaining why this doesn't happen. I don't think necessarily there is a lack of understanding. But there is this saying: Yes it's great if we can achieve those benefits, but the downside is that if we don't bootstrap ourselves, if we don't take the safe solutions, we are putting ourselves at risk - a great risk of losing our jobs, of being put out of commission and so on.

(53:32) I have another question. Before you said something about that the users going to the public sector saying that they want to open up

their data for the private sector so that something can be developed to help them. But how can you as a private organization create incentives for those citizens to approach the public sector and tell them: ok we want to open up our data? What kind of incentives do you think you need to provide to the citizens? (54:08) I think there are a couple of answers to that. If you look at the success of the mobile platform and look at how willing people are to share their data, sometimes it is ridiculous right. To get the most stupid functionality, people are willing to give up all friends lists and all the contact information and everything. And they gladly do it. They give up all this stuff. So in general I think people are generally willing to share their data if they can get some value. And you need to do it in a proper way, so if you for example do a light torch app then harvesting people's location data is not okay. That's not an okay exchange. But if there is some good relation between what information you are harvesting and how you are using it and the value you provide back to your customers, I think there is a pretty good trade off. And people in general are willing to make that trade off, so it's a pretty well-proven case that users and consumers are willing to give up their data pretty easily, it's sometimes surprising actually. Secondly, one thing we could do in Denmark is that we could empower citizens by law that they can go and ask for their data. That you as a citizen is allowed to ask for your data. Actually you have it, but only in an analogue fashion. You can actually go and ask for your data and then the public sector needs to respond in terms of all the data they have. But if you can transfer that to a digital parallel you are enabling your citizens to go to whatever public institution or private institution where you are a customer and say: I want you to share all the data I have with this specific person or purpose. I think you would see a strong incentive structure in terms of overcoming the data privacy issues and in terms of actually getting this market to grow.

(56:45) Kristoffer. Thank you, that was a very interesting point. We have run out of time and are getting kicked out of the room. But thank you very much for talking to us. No no thank you. And I would be very keen to see your research once you are done with it. So I would be happy to see it when you get to that stage. Of course. And we will definitely send it to you and contact you if we will use your comments further on. Thank you so much. Good bye.

A.2 Adrian Ulisse

(01:20) Thank you very much for taking your time with us, we are very greatful. Let's jump straight into the interview - is it ok that we record the interview? Yes, sure.

(01:45) And so, we are Mikkel and Santosh and we are doing this master thesis about open data governance and the crossing of borders between public and private sharing of data. Can you please introduce yourself and tell us about your work and role in ETHOS and the idea behind this **project?** (02:05) Yes. Let me firstly set the context of where I am – I'm just walking through London now and there might be some odd sounds while I'm going through these London streets. A little background about myself: I've been about 25 years in the industry and I've worked for some quite large systems integrators mainly in civil infrastructure, airport supports, oil and gas infrastructure. It was all about trying to deploy systems to help and manage the infrastructure better. Hence my interest in cities, because cities are an aggregation of a range of different infrastructures clearly not very well integrated today. (02:55) About six years ago I did my first project in smart cities, at the time called intelligent cities. It was a project out in Malaysia where they were building a new city for a half million people. That was very interesting because I learned that it wasn't a technology issue, it was actually a more people and organizational issue. (03:20) We visited every single government department in the city and found that lots of the individuals wanted to share or conceive data but were less comfortable about sharing their own data, which was an interesting observation. So I continued to work in systems integration and 18 months ago I decided that I wanted to set up a smart city business. I thought that with the help of Ethos, which is a kind of accelerator type of organization, and I got a number of quite exiting projects and associated funding to make it happen over the next two years.

(04:15) This part of ETHOS that you are involved in, the smartETHOS, what is the job and product of that and how do you work with it? (04:32)As I said, I hoped to set up a smart city business, but what is a smart city business? And in fact at the time I didn't know. Working for a big systems integrator, there is often a tendency to take a top-down approach and say that you can integrate all of these different systems, put lots of different sensors in the field, and it's all going to be great and wonderful. The question that often is not asked is: Why are you going to do that? What are the benefits? What are the impacts that are going to happen on this earth? Is a big top-down system the right way to go? I haven't had that experience. I thought: let's look at it from a different perspective and in a different way. With a more bottom-up approach, where you haven't got a predetermined position – you are just trying to understand what are the problems that we are trying to solve within a city. And so, that's what we really did. We looked at the city and thought: What are the common problems that cities face around the world, because we want to build a business, which is not just applicable to London or Bristol but hundreds of cities and towns around the world. So we sat down and thought quite hard and a couple of trends emerged over the cause of several meetings and discussions. One was about that a lot of nonsense have been made in the area of public transportation. I remember when I was growing up and waiting hours for a bus and imagine that I had an app – that can actually save some of wasted time at the bus stop: here one can see how technology have had a concrete impact. (06:45) (Noisy sounds from London) So we looked into private transportation, particular cars, which have navigation system that ensures one can literally drive from a to b without looking at a map. However, a person's journey is not often from a to b – its from a to b to c. We figured out that area in particular has been poorly served because there are some applications that had parking information but were apart from a parking app. Nobody want a parking app, they want parking data into the channel that they are using to navigate. So we thought there was an open data opportunity around parking.

(08.00) We also looked into the issues that are happening in the high street (the roads in the shopping districts in cities). There is a lot of change going on: lots of new entrants, online retailing having a big impact – lots of things are affecting the high streets. And, certainly, we have a problem in the UK as we are not careful regarding the heart of the high street will disappear, which is a big issue to social cohesion.

(08:55) How did you find out that there was a problem with social cohesion? Did you as anybody or did you just found the problem yourself? Well, you kind of see it here in the UK with many of the high streets now, where 15-20% of the streets' shops are empty. The shops that are still there, many of them are changing from shops that create economic activity to shops that are loan shops or (bad connection). (09:40) If you take out economic growth of your town centre, you are on a bad spiral. So it was from that perspective we saw it. In fact we don't have a place where people can congregate, and that's for young and old. The social cohesion of that community starts to be impacted. So that was a second area.

(10:10) So you identified the different areas within the city where you could see some real problem that was both involving technology and the social perspectives. We have had a look on your webpage and tried to find information about you and it says that you are focusing on integrated and sustainable cities. What is your definition of a sustainable city? (10:50) Aha. I'm not that into putting definitions onto things.

Then we call something else. Can you please just elaborate on the concept of a sustainable city? (11:10) If you ask in some circles, the sustainable city has a more circular economy as opposed to a linear consumption economy. That means a lot more recycling, a lot more use of renewable energy. My personal view is that sustainability comes from better integration across the various different silos in different cities where transportation and energy is very much interlinked but very much run separately in terms of how they operate it. Not one element works optimally in isolation, so even in the car-parking example that I gave, if you can get vehicles into a park box quicker, then they are not congesting the roads, which means they are not producing emissions. So in fact by optimizing your car-park and by that try to increase your revenues, you actually have a quite positive environmental impact and are therefore more sustainable. I think another thing you see happen across
the world is trend of sharing business models. E.g Uber and AirBnb are actually optimizing the capacity within a city. When you walk around in a city you start to realize that we are buried in inefficient use of our resources. A lot of buildings are half-empty or not used or there is just no one there. There are huge opportunities to become more sustainable just from behavioural change.

(13:08) And by means of opening up data I guess? Well absolutely. Uber is a good example and it's a data-driven business about trying to connect a taxi that is driving in a city to somebody that wants to move somewhere within a city. It's all data-driven and it's main the technology of smartphones that enables that.

(14:10) Our tricky question here is: Don't you think that that kind of behavioural change just increases the amount of travels, hours you will actually drive around in your car and by that increase general consumption? If you have smart-parking systems then you have more time to spend in your car as well. There must be huge rebound effects and is that sustainable on a long-term? (14:50) It's an interesting question and I've had this debate with a number of cities. They are saying: Making parking easier isn't that going encourage people to drive more. And it's a little bit short sighted in that people don't make decision if they want to drive just because they can find a parking space. There is a range of different factors of why people decide to drive or not. We have to remember that we want to see the world through the lens of today rather than the lens of tomorrow. With renewable energy getting ever more efficient and the rise of the electric car, I believe the cars are ever getting less and less polluting. That's an interesting fact in itself. When you start to look at the potential increase that there is in traffic congestion, a 70% potential increase, just from the growth of the country. So, in order to manage growth, we need to optimize what we have even more carefully.

(16:15) Ok. So let's jump back to what you mentioned about these different silos that you talked about – that different sectors are thinking in kind of business silos where they are not mature enough to see the potential benefits of cross-boundary or cross-sector thinking and sharing data. How do you think one can create incentives? What are the most important factors for creating incentives for these sectors to collaborate and create new business models? (17:00) I think central government has a point to play in this. The very nature of the central governments is broken into silos - from ministry of transport to ministry of energy etc. If you can incentivize local government by integrating at the central government level... If you are going to do a project where you are trying an initiative, then the central government will look kindly on more integrative projects, and that will change behaviour because in the public sector they don't live in a commercial world. The rules of competition and capitalism don't apply and therefore you need a level of incentivisation – I mean: where is money available? People in local government will follow where the money is. So you can make an incentive by saying: we want to do integrative projects and get more funding, we could raise more in taxes because we are becoming more efficient or we can drive out cost. There is a whole range of different plays that one can make on this. And unless there is an incentive to do so, people don't want to change. It's just a natural part of life really. In fact it's even worse than if we don't agree with the change that is being put forward generally people prefer to be right rather than being successful. They want to be proven that a given change was wrong even though that if it did happen it would have been beneficial to everybody.

(19:08) What you say, just to be clear, is that you have to start with a top-down approach somehow to be able to break down these silos? (19:22) I think you have to use the financial leaders to encourage more integrative thinking, and that might be by moving funding or making funding dependent on action. And I think, yes, probably more of a top-down approach if you a going to affect that kind of change. We have the saying that: Turkeys don't vote for Christmas.

(19:55) It's kind of a two-sided thing isn't it? Because for local governments to be able to think in this way, they also have to kind of get rid of their narrow-mindedness and break down their silos. Who are going to encourage them to do that? Is that your job as a kind of cross-sector thinker? (20:23) It's part of my job I think, yes. It's a necessity. If we in Europe are going to compete in global markets we need to get the right balance between cost-efficiency and services. I think we all recognize that the current situation is not affordable. It's interesting because taking it from a citizen's perspective, a citizen's view on this is: Why isn't this done already? I expect to live in a smart city and I don't understand why I – in this day and age where I carry a device that can launch a rocket to the moon, in terms of it's computing power – still queue up in the same traffic on the same day where something goes wrong with the trains and there is no information. That is what frustrates citizens because we seem to make great advance in some areas but not in others. The cities that crack this problem are able to be smarter, be more integrated, and be more sustainable just by being a city that makes it into their ordinary things. That is where we need to get to.

(21:53) It is actually funny that you say that because in our case, in Denmark, we strive for being green and sustainable on a long-term. And the government has made some very interesting projects about connecting the whole city and make a platform for Internet of Everything and generally connecting everything to be able to be sustainable in the long run. Even though the government has a lot of technical ideas, we are not living in a smart city and it's not going to be smart, it seems, for a long time, because they do not involve the business actors here, they do not involve the citizens. Something is wrong. What do you think can be wrong here in such kind of approach, because this is a top-down approach, which is only focused on the technical perspectives? They have a technical platform but not a business platform, so how can they make a solution for that? How can they actually put this into the market? (23:20) That's actually a very interesting observation because this is not just a problem of Copenhagen but also for other cities as well, where you have central government officials trying to react to something rather than actually properly plan. One of the big issues, and it's a wider issue than just for smart cities, is there is a level of distrust between the private and public sector. And there are some good reasons for it and some not so good reasons for it. We all talk about collaboration but what you are talking about there is actually collaboration between the public sector and the private sector and the citizens. Collaboration, certainly between the public and the private sector, is extremely difficult to achieve because of competition. We have got to a point where competition is everything and outcomes are secondary, which is a real shame. If you take your example of Copenhagen, it's similar to many US cities in that they take a lot of time building a data platform, publishing lots of data. But the reality is that the majority of the data is poor quality so it's very difficult to use. The understanding of what problem you are trying to solve is not being thought through. So as they may publish one data element you can't solve the problem without other elements of data and that might be from the private sector, it might as well be from citizens. One of the things that we are looking at is how to encourage citizens to use their sensor devices in their smartphone to collect data on behalf of the city – why would you do that? Share these data with the government? It's costing some of my battery time. What are the benefits for me? That issue has not been thought through. But to go back to the point I started with: if you can make solving problems that are personal to citizens important and integrate that into what you are doing, then you stand a much better chance. Some of these things are hidden and some of these things are very visible. A good example is Amsterdam. Amsterdam is fantastic in being a cyclist capital – probably the leading cyclist capital of the world in terms of people using bicycles. But I was these 3-4 months ago and one could see that there were too many bicycles all over the streets and all over the pavements in 3 or 4D. Bicycles are being left for years. And in fact it is a situation out of control. So how can you collaborate between the citizens, the city, and the business to create the opportunity to solve problems like that?

(26:50) Yes. That's also why we identified a kind of lack in research. It seems like there is so much research in the technical area and there is also a lot of research in identifying the potential value of such a collaboration, but seems like it's very difficult to find concrete research that actually motivates this kind of collaboration and identifies the concrete complexity, problems, and problems solving in this kind of collaboration. And so, of course we sketch out this conceptual normative model for accelerating this kind of collaboration. Do you think it is possible to have such a model where you increase the mind-set maturity among the relevant actors so they together can find out how to harvest this value to be found in crosssector collaboration? (28:15) One of the reasons why I say it's difficult is that citizens are generally lazy. The majority of us are lazy and we will expect things to happen for us and wonder why things don't happen for us. The engagement with the citizen peace is important - has to recognize that we are lazy. If we recognize that, then we are able to understand which engagements are actually useful. Being a member of the general public you say: Why wouldn't we be doing this? Why wouldn't the private and public sector be collaborating together to solve a problem around the high street or parking or energy? You don't need citizen engagement for the obvious. I think the issue of competition is a real issue – how do you incentivize the public sector and the private sector to invest and create solutions where all that value then gets competed away. I don't know the answer to that but I think things are changing. What I see happening is that there is an ability now to solve problems quite cheaply with cloud computing, smart phones, ubiquitous networks,

reduction in the cost of sensors. You can put in solutions to solve specific problems and challenges. That can be done without a huge competition – in fact competing costs more money than the solution you are going to buy. That said, there clearly needs to be some level of competition. If we move to Software as a Service, then are tying into a solution for a year, which you can chop and change as long as the adherence to providing open data is there and the data that is being produced is open and... Free is an interesting word, because having open data, there is always a cost associated with it, it's not free as in terms of its cost of production. So I'm not so sure about how you do it, with such a model that you think needs to be created, but what I would say is that we have not found all the value there is to be found by a long, long, long, long, way. There are huge amounts of new economic activity and value that can be achieved within a city. Just look at someone like AirBnb I'm not sure what their valuation is, but I'm sure it's in the billions of pounds. So here is a company that have created a couple of billion of pounds worth of value, a whole range of economic activity on top of that, and four years ago it wasn't there. You just sense that there is a lot more value within cities if you just take the time to explore it and work it out.

(31:50) And expose the existing resources in a more standardized way probably? Absolutely. Optimizing the resources in the city is essential. You just have to walk around in the city at 9 o'clock and you will wonder how to incentivize people to come into work in whole wider range of days. And that's already happening to a degree with some homeworking. And why does a company have a fixed office? Why are there not more sharing of offices? In a company building all the meeting rooms are almost empty all the time and there are lots of assets there that are not used very well.

(32:45) It sounds like this kind of sustainability requires a lot of behavioural changes and education of people? Yes I think you are right. I think it is a matter of incentivization: why would I do this? Again – what's in it for me as a citizen? Do my taxes get reduced? Do I save time? How do we make it cheaper for businesses? There is a whole range of issues and I think that relationship between the citizens and the city has been probably too much one way: We are the city, we'll take your money and we'll spend it on your behalf, but we never really think about giving it back to you by finding ways to reduce our costs more efficiently. And it's not about limiting or impacting social programmes, which are hugely important, but it's about actually being efficient in delivering services that citizens expect cities to be efficient in.

(34:12) So what you say is actually that we need to establish some kind of triple-helix ecosystem, which actually generates some value here on a long term? Yeah. Yes I think so. It's about finding the right frameworks and platforms, which business and the public sector can engage constructively together on. And as I said: focusing on the specific problems, which don't necessarily need a lot public engagement, because it is just so common sense things to do. As I said: If you walk around Amsterdam, you know that parking and driving of bicycles is a problem and is unsustainable. You don't need a big citizen consultation on that. If the city and a private sector company found a solution to it, everybody would be happy and think it's fantastic. As if two organizations goes together consider how to reduce the cost of delivery of water by a hundred Euros a month for every citizen, who wouldn't want to do that? I think one of the biggest challenges in all this is the institutional frameworks that we set up that stop collaboration unintentionally. We have in UK an issue around energy infrastructure: we have an organization called Ofgem, which is an organization funded by the government, to look after the interest of the consumer in the energy sector. Their job is basically to say that an energy company can't invest in its infrastructure unless there is an immediate need. What that means is that we have now got an infrastructure, which is probably becoming unfit to purpose and certainly unfit to potential growth. And so, what you have is a company that really would like to invest in the infrastructure but according to the rules it has to work with, it doesn't make sense for it to invest, because it can't get that investment back. The government department is saying: well I've got to try to protect the consumer so I'm not going to let you invest in this way, because you might overcharge the consumer. So you have got a situation where everybody wants to make sure there is enough power in the UK or in the city and its distributed efficiently. Everybody would agree with that. But the mechanisms in the institutions that we have don't support it.

(37:12) It's interesting about the institutions. So we have to actually evolve these institutions somehow. The obvious problem is: who are the ones to take this decision? Who are going to actually make these institutions mature enough to understand this? (37:34) Yes that's interesting. When we work on 4-5 year political cycles then changing an institution might be a 5 year job or 10 year job. We have got a mismatch on political cycles against the institutions that we create, and I don't understand the reason myself, but we set up an institution and however poor the institution is we don't tend to change it that much - it's kind of there and it does what it does, and even if it's causing a problem it takes a really big crisis for something there to go: right, we go stop doing that and then do something else. Certainly, a government that stays being in power for more than two terms often doesn't want to change what it set up in the first term. So it takes another government to come in and change some of the institutions that it doesn't agree with. There is certainly something around that, I don't know what the answer is, but you can just see a mismatch between these institutions and the ability to have everybody to work together collaboratively.

(38:54) It sound like the institutions need to be agile and correspond to the agility and scalability of the environment somehow with an agile mindset? That's a very interesting point because the people that tend to be heads of the institutions are not the most agile in society. They are very experienced and very ..., but they are not the most agile. We have a lord or a lady that is head of industry or government business department and their ambitions to make wholesale change is probably less so than perhaps other demographic within society. So maybe we should have institutions run by 10 year olds.

(40:00) We have come across your smart-dashboard solution. Can you tell us a little bit about that? That's a piece of work we are doing with an American software company called Socrata who are the world's leading open data platform organization. They have been doing this is the US for quite some time making what they call Data-Driven Decisions, which basically allow politicians to demonstrate the progress they have made and allow interaction with the data in a much more dynamic way than (bad connection). It's part of our portfolio but not something we push too hard at the moment because we are doing other things. Some cities are interested in it need to have a political backup behind it because it's more of a mind-set than it's a technology-led change.

Guys, I need to go now.

(41:20) That's actually perfect because we have run out of questions now. I would be very interested in your thesis once it's written. It could be interesting to have a read of that. And what's your plans following your thesis? What do you plan to do?

(41:50) Of course this kind of thesis really sharpens your attention towards what is going on out there and personally I would like to try to follow up on our research and probably apply for a ph.d. Okay. Well we are looking to expand our business overseas – not quite yet but certainly over the next 12-24 months, so if you've got time and you are interested in doing a bit of work for us in the future then. You guys seem to have the right mind-set, which is a really important factor. If you don't mind keeping your ears and your eyes on what's going on in Denmark, because it's an interesting market to try to access. We'll keep in touch. You have got my email address and contact detail.

(43:05) Thank you. And thank you very much for taking your time with us. You are very welcome and good luck with your thesis. Bye.

A.3 Søren Møller Jensen

I got your email with few questions and a bit of information and of course we could just go through that and but before that I don't know if you happen to see, I forwarded an email to you early this morning. (00:39) **Yes, exactly and thank you for that report and we had a very brief look at it and it seems like they are also touching upon a bit on the same kind of issues that we are addressing in some of the questions that we sent to you.** (00:56) Ya, I did not go through it at all. I just downloaded the report and hope I will have some time to read it later on. But the thing is, if you did not know it already, this Arup Company, the founder of the company has Danish roots and at some point the company was moved, I guess the head quarter is in London. And Arup is very much in to city development and working with. According to Martin Brynskov, which we had as one of the experts in our smart city report. He sees Arup as one of the companies that truly raise the smart city perspective from working across professional boundaries and trying to connect things in newer ways, which seems like they are quite good at challenging the existing.

(02:11) **Ok, that's very worthy for us to know of course.** (02:17) Could be a source of inspiration and also, they produce a lot of different report and you might find interesting information in some of that. Of course, it might be biased because whenever a company comes up with a report it's also a part of their branding but that does not mean that it is completely useless.

(02:46): Of course we will have that in our minds and also I guess you could also see from our email, kind of discussions we have had, it's actually through them and through a lot of readings that we have tried to narrow down our focus here because it is a difficult concept to narrow down to something specific for a case study like ours. So, as you might remember in the beginning we were very focused on the concept of sustainability, how that relate to smart city and how that would actually affects the different smart city initiatives, not only in Denmark but also in Europe and so on. And it actually seems like the concept of sustainability; the way we want to use it is very much linked to the things about the indirect value creation, creating a sustainable market on the basis of for example open data in our case. Just getting more value out of the resource than just the direct ones. (04.27) At one point of the report I have mentioned the value creation on a society level as oppose to the value creation on individual level. Is that what you are talking about?

(04:38) Can you please reformulate or may be I think there was something with the connection there. (04:44) Basically you see it within various markets of course but specially when it comes to Cleantech or other smart city related technologies, you very often see that the resources we have access to are publicly or the resources that are owned by private companies. Those resources can worth a lot more than just whatever purpose the company use it for, meaning that if we skip the privacy issue. Try to consider the data held by the telecom companies, they have loads and loads of data but those data might be valuable in so many other ways if they are opened up or can be accessed by purchasing those data. (6:03) So by combining it and aggregating it with other kind of open data you mean? (6:08) Well, yes and using it with other businesses as well. So you can say that as a resource, the telecom data you have today could be used in many other ways than what they are within the telecom industry. So, you can see that there is a potential there and if you manage to unfold that potential you will have an extra value created within society and this could go for both the resources that are publicly owned and the resources that are privately owned. But, there is a huge but (07:05), it is much easier to describe or formulate how that value can be extracted on the society level. I mean you can also formulate how it can create value in the individual level but the thing is if this is going to happen, you would need some sort of ability or desire to pay at individual level otherwise, you would have say if you have all of those solutions be legalized through taxes.

(7:52) So, how can we create these kind of incentives on an individual level because that is, I guess, what you say is necessary to be able to create this kind of .. and now we are getting in to the subject here to be able to create an ecosystem with relevant stakeholders and so on there has to be individual incentives as well. (08:18) Yes exactly, I am sorry if I am getting ahead of agenda and we can easily come back to that but just one quick remark, you can say that, probably within the energy sector, one of the thing that one could imagine is that data related to energy usage is owned by the end user, meaning that for your own household you are the owner of the data related to your usage of energy. But the energy companies of course also have the access to that data and they might use it for various purposes but you can easily imagine other industries being interested in those data. The thing is, I know it's not like economics studies you are going to carry out but you need to consider what would might incentives be for me to open up the access to that data for another company. Imagine another company for example within finance or insurance, if they get access to a wider pool of data then they might be able to offer some sort of service not necessarily a physical product but it could be some sort of other service. It might mean that if they are able to recognize me as a part of a lucrative segment of users instead of a less lucrative segment of users it would be less risky behaviour. If they identify me as part of that segment they could be willing to offer me some sort of discount or premium product as it is in insurance and more or less only through access to my data on energy usage. I mean you should consider information as a payment or else what could be the thing that makes that solution possible instead of financial payment.

(11:12) So this is I guess what you kind of address in your report as getting out of this silo thinking mind set? (11:21) Exactly, well that is one of the things. (11:30) So, what we want to kind of investigate is that what does it require? You said that it requires an incentive on individual level to get out of this silo thinking but it also I guess... (11:48) What does it take that is one thing but, I mean with the incentives that is on individual level for example as a citizen I might think that it is an extremely good idea to have the regional authorities of the municipalities role out wireless communication that can be accessed free of charge but as an individual I might not be willing to pay for that whenever I am outside my home because the solution I have from my network provider, where I have my network access that might do the trick for me. So, even though I might be able to get the better service if the municipalities or another provider rolls out wireless communication through out the city. I might not be willing to pay extra to get that solution that is more valuable than what I have already. Should I? So, that is on the individual level but the other thing with the silo thinking is, its not only dealing with the things we just discussed, its also a very important manner as for the ability to see new connections, how your professional sector might relate to the other competencies and also it's a matter of mind set because you need to proactively challenge your own competences and the area you are working within and how that might will be able to relate that to other areas. You cannot just do that just re-actively (14:14) because very often if you only be re-active you will never see the possible new relation, you are very likely to get stuck within your own area.

(14:26) So, this is actually where we thought it might make sense because what you describe here, it sounds like you have to be kind of smart city mature to be able to do this more holistically and when reading your report it seems like you have to be in some kind of maturity stage to be able to think out of your own boundaries and so on. (15:04) Yes, you can say that but that is unreasonable(15:08), I see that it is very important that you have the courage to challenge the solutions you are working with. You have to accept the fact that, for example the concept of a city that is so complex that you cannot plan your way out of every little detail. You need to accept the fact that as you start out building whatever you are building and trying to come up with their solutions, you need to accept the fact that you do not know everything when you start out. You need to accept that things are going to happen on the way and you need to be agile and adopt to those changes on the way.

(16:12) So, for example creating a very big infrastructure or creating a kernel for creating a new smart initiatives and so on which we see in Copenhagen, also from Copenhagen Connecting and the Big-Data Infrastructure and also from Big-Data basic program. Are those kind of investment future safe actually? Are they agile? (16:41) Well, that's very important point here that you don't know whether any of your investments are safe because whenever people are talking about planning, that might be politicians or that might be CEO's, when they are talking about planning they are creating an illusion that they are removing uncertainty but the thing is when you are dealing with a concept which is so complex as of city, its not going to be more than an illusion that can remove that uncertainty. The uncertainty is going to be there anyway and with that uncertainty you can never be truly sure that your investment is safe. So, the thing is how do you handle it and try to minimize the risk to that investment. And in that field it seems like there is a divide between companies and public authorities. When we interviewed a whole lot of companies we heard a lot of them complaining how do the public authorities and the municipalities lacks courage but the thing is, its very easy to say that they should be more courageous but then when you have a huge investment which fails and we have seen that couple of times, take for example Rejserkort and in that case you can see what failed. And in that sense I believe who ever come up with the idea that we need to make big investment, they were probably not so loud when the project came out as a failure. That means, whatever development you are making, it needs to be incremental rather than a revolutionary

and it also means that for incremental development to be successful you need to be agile, you need to be able to change the perspectives along the way. It is more easy in theory than it is in practice.

(19:38) For us, we have only looked into this area for 4 or 5 months now but it seems like specially Copenhagen and lot of constellations in Copenhagen are trying to create or, it seems more like a revolutionary approach, creating an ecosystem just like that. I am not sure if I am right, it seems like that is what they want to do or it just seems like a very difficult process to formulate a concrete vision for using, for example open data for creating a new kind of a platform. It is much easier to sell these direct value creation but this indirect revenue seems like a very difficult thing to unleash the potential of. (20:48) That's true and it all starts out with a mindset. I mean, I am referring to it in my report and this ability to have the current challenge, the existing solutions (21:16), with that you believe that you can actually gain something from trying to come up with new solutions, even though you cannot formulate those new solution in detail when you start out and I see that with same way with open data that you need to invent something. Sometimes if you have access to the data its just the time effort to try to see what values lies within that data. So, in one hand the opening of new data sources is a big step because if you want to make your own small experiment with data, it is much more feasible to do so if you have free excess to those data. If you need to pay for those data sources, you are much more reluctant to go out and purchase those data. You will only do so if you have a very clear cut business case and there are more or less, if not 100 percent sure than 98 or 99 percent sure what revenue flow, what profit you going to make when you work with those data. But all the sudden, if you have access to that pool of data, you have few ideas or challenges that you can solve those in that situation, you can go out and experiment a lot more because the only thing you need to invest is your own time. So that makes huge difference, for example, you can say as a startup company, if you want to startup your small company you need to be very aware on whatever cash flow you have and what cost you have but if you have free access to data, you can try an experiment and of course with a start-up company, you also have time (23:43) scarce resources as well, but it makes quite a bit difference. So, that is a bit upside or that is a very big upside as I see it in terms of creating innovation because open access to resource potentially do a lot of good things.

(24:03) But there is certain kind of innovation, it is a kind of innovation which stakeholders are not... it seems like that they are just not mature enough to be able to understand the kind of innovation they can make and the kind of value they can extract from this kind of data. (24:27) That could be a valid point and this is where the market is very important source and even though we just try to focus a lot on triple helix (companies, public authorities and knowledge institutions) because, first of all the public authorities they own some of those resources they control how the resources are handled and how the infrastructures build up and at the same time they are also an important part of the market because they need to have various tasks done and they create table in order to keep solutions for those tasks. And you of course have the companies who are the ones most well suited to come up with commercially feasible solutions (25:31) and the most cost effective solutions and finally, the knowledge institutions, of course, they can be (25:39) trying to direct the development within a field and they could also be a very important sort of these independent partner, they can be the one trying to create a link between public authorities and companies because very often we hear companies complaining that the municipalities for example they don't get the ideas of what the companies technologies are able to do and on the other hand the municipalities are very afraid that they are going, you probably know the concept of lock-in, so of course the municipalities are very sacred at this stage. They have a tender and they choose a supplier that supplier they might be locked in and get very dependent on and they would need to avoid that and there could be other issues as well. Think, for example, some of the (27:03) very very huge global corporations within various IT services, even you are in the city of Copenhagen, you might feel intimidated by international companies that did. So that is a battle of power here (27:26). It might not be something that they consciously engage in but I believe that at least sub-consciously it can have something to say and actually just bring a note on another level and you can say that, in Denmark we might not be the biggest fans of very huge corporations. So, in that sense, the citizens might be reluctant towards supporting the municipality engaging in corporations with very large international company.

(28:14) Ok, so there is a public resistance or citizens resistance towards that? (28:20) That might be in a broad sense. I don't have any particular references for that but you can say the way we talk about companies and the way it seems like policies towards start-ups. Policies towards companies, in many ways, are more focused on the very small companies and whatever they can do, instead of very large ones because we tend to believe they can take care of themselves. So, some people might even take that as a democratic problem, if municipalities (29:20) enters corporations with very large international company because, it means, they all have international company dictate (29:30) whatever is going to take place in that municipality.

(29:33) Isn't that what is going to happen with big data infrastructure now, somehow, if that those who wins the tender might be, I don't know if someone already have won it but Hitachi is kind of a very big player? (29:50) First of all, the tender has not been settled yet. I guess the specific tender is running right now. Everything that has happened until now is the pre-qualification and there has been competitive dialogue or whatever term you use in English. For example, the city of Copenhagen has been in a dialogue with the companies showing the initial interest and I suggest that you talk to the people at Copenhagen Cleantech Cluster or CLEAN, as it is rightfully called that (30:37). You talk about the big-data infrastructure. Its bit difficult for me to say what the power would be or how much that would be controlled by whatever company wins that tender and I guess it might, this is a bit like, for example DANIA Denmark, (31:04) who has the ownership of all the railways and I mean that you have one part that could either be a company or public authority or public company, that is not necessarily a thing that is going to hurt the free competition in companies competing with each other on top of that infrastructure and I see it from the same way with this big data infrastructure.

Whoever wins is going to have a task of running that infrastructure but whatever happens on top of that they are not supposed to restrain and I don't see how they could restrain that. I mean if we engage in a very technical discussion that it might be possible to restrain (32:15) but basically it is supposed to be an infrastructure, which can subsequently be accessed, by lots of other companies and public authorities or whoever.

(32:31) So, I think we will talk to CLEAN and ask them more specifically into their ideas about tender ship. If we go a bit back to your emphasis on triple helix and the importance of thinking about the triple helix when doing smart city solutions or initiatives municipality wise, there are many stakeholders to be included in such kind of very big initiatives, who have to have mutual understanding of how to utilize the infrastructure, I want to get a bit back to this maturity thinking about how to create lowering the potential risks when doing smart city initiative, kind of coming up with the guide for the decision makers in the triple helix, a guide which can be based on the maturity levels of the other stakeholders to be able to, again go into a more into incremental approach creating small investments in beginning, which can incrementally increase the maturity of the other stakeholders as well. So, that kind of goes hand in hand. its just our hypothesis at the moment but it seems like that is a necessary thing that it goes hand to hand that the risk and the maturity in the smart city initiative. Can you elaborate on that? (34:32) Well first of all, on this part, I believe that I would recommend that you consider (34:46) discussing such with somebody who is more specialized within the whole field of how to run these processes. I have some sort of idea but not on a specialized level and the department of business and economics or something like that or somewhere, you probably should be able to get in touch with professors or other who has very specialized views on this.

(35:27) So you mean academic persons? (35:31) It could also be hands on people from business line but it could also be people with academic background. And, if we come back to the complexity of this thing, there is this paradox, if that is a very complex concept, basically you cannot follow that in a normative way saying that this is the correct way to do because of the complexity. Basically, every city or every project within every city could be so unique that you cannot..., you need to learn along the way.

(36:41) So you can say that system approach does not work in a city? Well, I suppose that it relates to the system approach. It has been quite some time since I studied system approach from the theoretical perspective. So you might know more about that than I do. But the paradox is that you need to balance it some way. Instead of saying that it is so completely complex that we can't say anything, you might try to formulate some overall indicators.

(37:29) That is exactly what we want to get into this, If generalization or categorization or anything can do something good for smart city initiatives. (37:55) I did not spend that much time or that much space on my report

on that but in some of the first pages we are referring to wicked problems and you might find an inspirations of that as well. I mean, one of the overall categorization we are trying to focus on, that is on mindset and you can say that the willingness to actively challenge whatever existing solutions you have. That could be one of the indicators you have.

(38:40) That is what we would like to call a maturity. (38:55) Language wise you need to be careful what terms you choose and how you are going to formulate that because I don't recall it, but did we briefly discussed that when Google purchased Nest earlier this year.

(39:13) Yes we discussed a little bit. (39:15) You can say that from the maturity perspective, I mean language wise, from maturity perspective, Danfoss(39:26)has a problem. May be Danfoss was too mature. So you can say that it depends on what the meaning you attached with the term maturity. Danfoss might be a good and professional company in so many other ways but in this perspective I could easily see how the age of the company might have been a huge obstacle for them.

(40:13) I guess that's also the age of a company can make it a less agile and a lot more silo type as other new small companies. (40:30) This is typically due to the fact that you were successful in the past. I mean, it is very very human to stick to whatever makes you successful in the first place. What I mean is, once again, it is much more easy to throw up theories telling you should do differently but doing that in practice is very very difficult. But very often, that is the case that you get blinded by whatever majors puts you in the first place. Look at the music industry, that is one of the most horrible examples. They were driving in truck loads of money and all of the sudden they were overtaken by other competitors and other industries and they did not see it coming or they did not want to see it coming. That relates this to the mindset of some sort of maturity, you can call it mature decisions. I am sure you will come up with great words (41:50).

(41:50) Of course, its kind of a working thing, working word of use, working definition but it refers to legitimizing or generalizing in the smart city context. As well as, as you have done, other wicked problem areas for example as culture, a lot of people and organizations and so on, where a lot of researchers have generalized and something good has come out of that but it seems that it could be interesting to see if generalization could be beneficial for the smart city agenda. Generalization in common terms, for example models, categories, for example maturity wise, for accessing the maturity of stakeholders. If you can actually create models for accessing this maturity or their ability to think holistically which can provide a guideline for decision makers to minimize the risks. For example, that's the generalization it might not be legitimate generalization but it could be funny to work with it. (43:31) Actually, what we also briefly discussed, when talking about sustainability, you might look sustainability from a democratic perspective and I could see that you could have indicator related to the level of dialogues, the level of involving citizens. Normally, that would be public authorities involving citizens but actually it might as well be companies involving consumers. Say for an example, if a large international corporation wins the tender for whatever service within the city and if they take by themselves, we need to be aware of this whole democratic perspective because otherwise we might end up being very unpopular. How could you go on about that? You could go about that by engaging citizens in many ways, with discussions of how those services are going to be shaped and how those services are going to be rolled out. That could be democratically more sustainable than the other solutions. Do you have direct contact with Martin Brynskov and have you talked to him?

(45:21) No, we have not. (45:23) He might be the source of inspirations for you as well. If you are looking my reports, on page 53, there is a small paragraph, 931, about two experts been involving. Martin has loads of information and knowledge about smart city development among others. He once mentioned that the city of Dotland (46:30), not so long ago, in cooperation with IBM(46:36) and of course you have lots of cities around the world cooperating with IBM so that is not a big news, but apparently IBM is working with Dotland on quite another level than what you see in another cities. Martin is not going to say that they handle the challenge in the right way but it could be seen as an example of a city choosing to enter cooperation with large international company and now the question is, how should that company approach whatever or however they are going to develop and implement their product and solutions for that city. Basically, it might be just an example of what not to do but it also could be sort of starting point now. What is they have done and if over next couple of years they are going to do it in different way.

(47:48) We will definitely try to contact to Martin Brynskov. (47:52) If you are looking up on the Internet, there should come some lectures or contact information as from the university of Arhus. You should also know he is a very busy guy but he is also a very passionate guy. If you approach him with a right message, I guess you have a decent chance at getting his attention.

(48:34) I think we need you to briefly introduce yourself and explain your role in Copenhagen Capacity more than we can just find information about you on the Internet. (48:51) That's a bit tricky because as it is writing down my role at Copenhagen Capacity expires on Monday but that's because the job I have had in Copenhagen Capacity has been directly linked with specific projects and that project is going to be terminated over the summer. I might work with Copenhagen Capacity but we do not know yet. So you can say that the role I have had with Copenhagen capacity directly link to this project and its something called SPI (49:40) in Danish an abbreviation of Samarbejde om Proaktiv Investeringsfremme (49:45). Basically, cooperating corporation regarding proactive national promotion. But that is one of those crabby formulations you find whenever you engaged yourself in projects like this. So you should not take that much notice of that. But some of the targets and objectives for that project has been to settle in cooperation (50:24) with 15 municipalities through out the Copenhagen region and I can send you a link of project website, which explains the project a bit more in detail. As I can see it, unfortunately, we only have that website in Danish but you can go on with Google translate but basically, within those projects, Copenhagen capacity has to grow as a project area(51:08) and then we have 15 municipalities through out the region, also working on this project and some of the targets relating to the project has been to get foreign companies to launch a business in the Copenhagen region and that has also been one of the huge troublesome (51:42) project because it has been difficult to obtain(51:47) this. We can talk about maturity level once again, actually the municipalities corporation with each other and in that way they have engaged with other municipalities. That was one of the target as well because those municipalities need to learn from whatever experience other municipalities might have and in some ways instead of one individual municipality running tenders on some sort of products or services, they might work together with more municipalities about that.

(52:38) So, have you also touched on the monopoly breakdown project? I guess you have. (52:44) Not specifically, when it comes to sustainability actually one of the challenges is that strategic energy planning takes place at (53:03) the municipalities level today and that is one of the areas where you can say that, I don't know that could be the area of interest for you but you could say that the problem with energy planning is that energy infrastructure goes so much further than just in single municipality. It actually is a bit absurd, in some way, its not very smart to have each individual municipality caring out the strategic energy planning because they need to coordinate with other municipalities. So, you can easily argue that should be taken to a higher level. For example politically.

(54:03) And of course that requires new abilities, new working processes, new ways to think, out of the box. (54:14) Exactly, when it comes to open data, there is another example; it might be interesting to you. I went to this local energy company on Bornholm and I talked to them about the eco-grid project. I don't know you have heard about this or not. If you go to chapter 7 in my report, it is briefly mentioned. It has a lot of partners involved, both the local energy company on Bornholm called Østkraft and it actually has some huge companies like IBM and Siemens being part of it as well. This project involves a lot of things but among others the local energy companies have mapped the heating sources of every household on Bornholm and based on that they have created a complex data model, which is used to forecast the usage of energy on hourly basis. So, based on that model they have quite specific knowledge of how much energy will be consumed every hour or every day based on seasonal differences, whenever people are on vacation or not. There are lots of variables involved in that and you can say that from the data perspective. I know that this energy company would like that data model to be used other were as well and I guess I can say this to you that they are (56:59) considering the other municipalities. Currently the data model is at a development level where they are trying to use it as informative (57:21) but they are accepting it and I believe that later this year or by the beginning of the next year they could be at a stage where they would be able to go out and commercialize it and do other things with that model. But you see this could be a sort of basic challenge, they have a lot of data on energy usage and they have a lot of data on the needs of energy usage but how to use that in other areas. It's (58:25) either one of the contact person in Østkraft or you also have the local business center Bornholm that's a sort of a public institution trying to attract companies to Bornholm and they are working closely together with the energy company, Østkraft, and it could be either one of them you can and talk to.

(1:01:23) And just very briefly because you mention what is the biggest challenge for Copenhagen Connecting to be successful. Of course, we have been discussing some of it but obviously there is also an economic reality, it faces here and I believe from the democratic perspective, the thing is politicians are often blamed for not being visionary enough and its not that I don't agree but I can easily see why they would be a bit cautious because if you are the politician who gets to be known because you launch this huge initiative and it failed big time. I mean, you are a dead fish. You can lay your political ambitions to red (1:02:28). It means that there is this very logical reluctance towards spending a lot of money on large initiatives, actually on uncertain initiatives. And this is a part of a challenge for Copenhagen Connecting as well because it's a great idea they have come up with and there are so many fine ideas within that project but still the municipality is reluctant when it comes to allocating a right funding for it.

(1:03:12) That's very interesting that you brought this up because we have also thought about this. This is actually what we would call a political maturity in smart city maturity. I guess you can see the link. (1:03:34) Yes of course and I mention it at one point... (1.03:55) When it comes to an infrastructure, sometimes there is a challenge that when you have democracy you need a broad topic to understand the various concept and if you don't understand those concept you might be constrained. (1:04:19) And that might be infrastructure for example that people are very much aware of the concept of highway or railroads but the concept of wireless communication through out the country, for example, that is much more difficult to grasp like what does that do to us?, How does that help us in the society? I mean, if you go down that road it does not take you long to loose the understanding of lots of feelings (1:04:59), lots of citizens. Its not that difficult to figure out, if we build a highway what can we do with that? Well we can have cars and trucks and others driving on that, in that sense that's very easy but when somebody suggests that we should use a truck loads of money on this wireless infrastructure. But why? Its not even visible. Even some of the bridges across greater belts, across Øresund has been widely discussed. Well, it's the physical construction. You can see its there. We know what the money was spent on and we pay for it. I mean the society needs to be mature and that is society maturity when it comes to digitalizing products and services as well.

(1:06:12) And digitizing society is also a part of understanding the indirect revenues instead of these direct revenues of having a bridge. (1:06:27) Exactly, but you can say that if you manage to come up other ways of financing, the other ways of constructing financing scenarios that might be the way to figure out how to get those infrastructures implemented because you know that whenever you spent billions of kroners on some sort of public infrastructure you always have people complaining that you should spend that money on something else. And you will have the tabloid showing pictures of the people who are ill and need treatment instead of building new road or something like that.

A.4 Henrik Korsgaard

(01:35) Before we start, can you just mention briefly your background because you only said Aalborg University Copenhagen, which can be many things. So could you both say that? (01:50) Yes we can. We are two master students from Aalborg University Copenhagen and we are taking the education in Innovative Communication Technologies and Entrepreneurship with a specialization in Business Development. It's a Master in Engineering. For our thesis we have chosen this very hot topic right now about open data platforms, what they also call a big data platform. So that's our main idea behind our thesis. We have to emphasize that we are engineering students. And so, of course we have a technical background where we are in this border between the business and technology issues. (3:00) Ok. I know that border.

(03:07) Before we start, is it ok if we record the interview? (03:10) Of course. So you have already got this interview guide, so can you please introduce yourself and tell us a bit more about your research, what you are doing, and how you are doing it? (03:30) Yes. So, I did my Bachelor of Arts at Aarhus University in Information Studies and I did my master thesis or candidate there as well. I have focused mainly on interaction design as a tradition and methodology but have been working a lot with cities. I don't know if you have seen my thesis which is called... ah... something something. So I'm, just as you are on the border between engineering and business, I come into this space between interaction design and urban planning in some essence, and also policy and business from a different perspective. Now I'm a PhD student at the Computer Science department at Aarhus University and my topic is not specifically on smart cities – I can come back to that a bit later – but it's a micro view on the city on what happens and how we can prototype and work in an urban context when we do technology development in particular. So that's what I do. I wouldn't say I'm a smart city researcher as such right now.

(05:10) Before coming to our very specific topic we would like to talk a little about the smart city, because it's a kind of buzz word right now. Everywhere they are talking about the smart city. In your view, how do you define a smart city? What do you think it actually is? (05:33) So, it depends on the perspective. From a business perspective it's a really really good business opportunity. And if you take a governance side of it, the side of the municipality or city CEO, he would say that it's something they need to consider. And if you take an academic perspective on it it's just... as you say, there is a lot of buzzword in it. In my previous work I looked at all the previous versions of the smart city. So every time a new technology becomes dominating in society we tend to conflate the technology with the word city. So we have an information city when we were focused on the information highway and now we have the smart phones in our pockets, and quite naturally we have called it a smart city. So I would say that somewhere in that fuzz lies a definition, but I haven't been able to extract one clear cut definition. But what I would like to point to is that from a citizen perspective and from an everyday perspective, there is no smart city. It's just a city. Citizens expect to have digital services because they have it in their university and in their working place, so quite naturally we expect the city to deliver the same kind of service. So it's just a city, and that's part of the challenge.

(07:20) Ok. Thank you. We tried to look into the smart city and a lot of papers about smart cities write about what actually needs to be smart and such kinds of things. We have also realized that nobody actually focuses on the citizens or social perspective. People talk a lot about the technology perspectives and we do believe that we have the technology to make our cities smart. We can build up different systems and connect them together, but nobody has realised the necessity to see if the citizens are able to use it to its highest potential. Who are these actos that actually work to build up a smart city? We have governance actors, private organizations, business institutions, and the citizens, and the academics. (08:42) The so called quadruple-helix. Yes exactly. It seems like most benefit come from when these actors have the same level of understanding of what a smart city is? (09:02) Yes, or I would say: when there is room for all four. Because a municipality, a business, and a citizen have very different conceptions of what smart cities are. A smart city should be able to give room to all these perspectives, right? And when one becomes dominant, then the holistic view breaks down.

(09:45) But how can you deal with these different public and private organizations in coming up together for building an integrated smart city? For example if we say that you have written a paper about involving citizens to inform the municipality. How does that work? (10:37) So, there are actually a few challenges in that. First of all, the municipalities are driving from a perspective where they actually want to involve the citizens. The business side is bit lurking behind, waiting for cities to actually make tenders or just buying their systems. So IBM are of course marketing their systems and they of course want to be in this space, but they are waiting a bit for the cities to make a tender, if you know what that means? So that's kind of problematic relations to get business in. And secondly, it's very difficult to involve citizens because they have absolutely no clue about what we talk about. Most citizens don't even know how a municipality operates. So it's very difficult to involve them. But what we did in that particular project was to involve people form the city of Aarhus, the municipality, which had an interest in the open data side, and then we involved consultancies and smaller companies that were curious about what open data could or what it is. (12:09) And the we had a few interaction designers and a few academics representing the perspectives of the citizens. So we kind of had the value of: so what does it mean to have this open and transparent and democratic and how would that look if we start developing it as such. But we did not involve any particular citizens in the design process as such. That is very problematic and it's also a big challenge to involve citizens.

(13:00) What were the main obstacles when doing this, when trying to grasp this from a more holistic perspective? (13:10) The main obstacle is that everybody working in this space is employed or working from a particular perspective. So if you are working in a municipality, you either work with sewage, traffic, or child

day care, so you have a very narrow perspective. You see one slice of the holistic pie, so to speak. The same goes for industry. You have a market, where you don't sell holistic solutions. You sell solutions for a specific market, right? If you sell an iPhone, you don't sell day care. And even as a research, I'm in computer science, so I also have a very specific focus on the technology, even though that I'm trying not to. And that is the biggest challenge – that is, changing their perspective.

(14:19) So you mean kind of have a mutual understanding of each others perspectives and how each of the actors can harvest the value of opening up data? (14:36) Precisely. Understanding the needs of the other and understanding that what is valuable for me, that is both for private and business levels, is not valuable for you. That is what is changing with the smart city. That we need to be able to understand... you are probably familiar with normal value chains, right? Normal value chain management, where you do horizontal and vertical and stuff like that, it's a way to look at the pipeline. But here the idea of the value chain breaks down because the value chain becomes so distributed throughout the system, and understanding that is one of the big challenges.

(15:30) What we have identified from reading different papers is that the whole city as a concept is actually going more towards an organizational concept. That's actually how we want to do it - see if it makes sense to see the city as a system. Like you can see an organization as a system and try to generalize a little bit. (16:00) Yes, but it's a challenge both in the abstract, understanding that the normal value chain is changing, and also in everyday transactions and collaboration understanding that you might not be creating value that is directly returned to yourself but it is distributed along a very complex network of stakeholders. So one case could be that the city releases some data and that costs the city, let's say, a million Danish kroner and then somebody makes a business creating an application on these data and the application might generate some revenue and it might even create jobs. So if it creates 10 jobs the city gets the investment of 1 million kroner back in tax revenue and that's a very complicated thing to understand because the guy having the data in the city, he wants some money back in his budget but he will never get those money. So that's where the value chain breaks down.

(17:19) And that's where the in-maturity of the current regulators and so on comes in? (17:30) I'm not sure that they are in-mature. I think a lot of people understands this but it implicates how you do a city budget. You have to give, for instance, a guy in the traffic department a certain budget to fix the street, to set up sensors that can harvest data and so forth. But you wont be able to link what he does to what a business does.

(18:05) Yeah that makes sense. Then ok, from your perspective as an interaction designer, how do you want to address this issue? (18:20) I wouldn't call myself an interaction designer. It doesn't really make sense because I mostly produce academic papers and I sit in academic institutions. But I'm not sure that interaction designers can do much about it, because... You have probably seen different data visualizations, right? Where people try to visualize relationships,

maybe the cause of a relationship, but also very complicated relationships. That is something interaction designers can contribute with by doing - actually doing applications that highlight this, or make applications show this problematic relation between data and value and the stakeholders involved. I think this is a policy issue actually.

(19:25) So it should start from a top-down perspective, and it should be the policy-makers that take the initiative to make people and actors understand that they can benefit each other by opening up data? (19:42) Yeah, and in that sense, as an academic, I've been pushing for the last four years for opening data mind and my role here is to both be able to talk about the benefits form a citizens perspective and from a city perspective and from a business perspective. And sometimes you need to address the stakeholder by talking about how the value chain might look. Sometime you need to make data visualizations that illustrate this complex relationship. But I think that in my work I advocate for, or I deal a lot with this as micro experiments. So, instead of doing a fancy power-point show where you show that this data goes here and this guy can benefit from it and you will get tax in return, I actually try to build it to explore and verify that my ideas about this micro machine are correct or show to the stakeholders the complexity involved.

(21:00) All right. You also emphasize, in the paper about prototyping smart cities (Korsgaard and Brynskov, 2012), that you wanted to explore the readiness of the municipalities to provide data. How can that be explored? Well, we did just that project. So. I don't know you have ever been involved in a municipality or with stakeholders that are not your peers or your friends in your own organization. But people tend to say: Well, I'm investing my time, so I need to know what is the value for me, right? And another thing that is challenging is that when you talk to people who, this is somewhat an accusation, but people who haven't got an engineering or computer science background, they tend to make everything data. So we wanted to show the municipality what data is and what it can do and what's the danger in working with data. I don't know if you are familiar with the data we used for that project, but later it was discovered that there were social security numbers in the dataset. That actually came in the national news and that is one of the things that we need to be able to explore with a city so they know that when we make stuff open we need some quality insurance.

(22:50) Okay. I guess there also have to be a lot of incentive structures in this. We have talked a little about it, but how do you establish these incentive structures for different public/private parties to participate in all this? Well, as I'm in a university, I sometimes have a different kind of access. Sometimes we have collaborations or projects already paid for, so that enables us to actually just help them get the data out without having to provide an incentive for it, because in the two projects I've done specifically with data in my masters, and later on my time was paid for by university. So they did not need to allocate money. And then the incentive becomes much looser, right? But I guess the task is to start providing some good arguments for releasing datasets. So for instance you ask the municipality.. every time a journalist asks for 'aktindsigt' - for all the detail in a case - it costs a certain amount of money to do the quality insurance, to get the data out, to provide it in a file and send it to a journalist. If that costs the municipality, let's say, 10000 kroner each time, and they have a hundred of these requests yearly, then you can easily say: well, if you make the data public you will save that 100 requests yearly and the time going into preparing it and the costs of that. So for particular areas you actually make a very specific scenario, or cost/benefit business scenario. It might not be real but it is something that speaks to how they handle the budget, what value is to their budget.

(25:04) It seems like the most important kinds of incentives are the economic incentives. If you think a little about it, that might also be a bottleneck for the sustainable smart city, because when you create these economic structures and static value chains i guess it's not that scalable in the long run. (25:36) I think there are many reasons why we talk about it from a very narrow economic perspective. And that's how we've chosen to make our society and so forth. I mean, that's how municipalities do their budgets and that's how we think about a service. But I think that part of it is also asking, with all these different services and all this data, which are actually produced by the citizens, then it is a question of discussing the ownership, right? I would say that the economic argument is worthwhile researching and investigating and arguing for that this is something that a digital municipality should provide. It's a part of their service just like clean water, daycare, infrastructure, so forth. It's the digital infrastructure. But that's an argument that is pretty hard to push forward in municipalities that have a lot of economical pressure.

(27:06) Can you please define what social sustainable growth is? We read about this also in your paper and it seems very important for making the city smarter. (27.30) That is a different value system than the economic monetary value system right. Every time you make a new system and change the existing systems you need to take into account the consequences of this. Just as the value chain is breaking down and becoming more distributed, so is the cause of relationships in the city. So, every time you build a new system where you take some data in, you might marginalise and hurt somebody. It might be privacy issues, it might be who has access to a certain area. It's something like when you talk about the digital dividend. Now that everything in Denmark is moving to NemID and digital mail somebody is left out - e.g. people with reading difficulties. I mean, as a business you can just give a f*ck - pardon my French. Google do just no care if they can't. They are legally obliged to care. That's how the sustainable growth perspective changes in my perspective - when we talk about citizens and not users. Google has users, the municipality has citizens. That requires a lot of considerations.

(29:23) If you look at the whole smart city then is it not sustainable just by opening up data and providing a lot of technical solutions to some common problems in the city. So that's not a sustainable approach to the smart city? (29:48) It might be, but it depends on the data and it depends on... Every time you make a change to the system... Technically and legally... I mean, policy and regulation should go hand in hand with these new technical possibilities. So you can't just talk about open data without visiting the policy side: who owns the data? what are the legal requirements? who can use it? what about privacy issues? Do you know the Danish digitization board that ensures privacy for instance? In Denmark the tax body can't combine information across systems, because that's illegal. But when you make the data open everybody can do it. How do you handle that? That's a different chain breaking down, right? And you can make all kinds of technical implementations and show that you can access this service at that time, but when you do the technical implementation you need the policy as well.

(31:30) But by policy, do you also mean that policy covers the social sustainable growth? Yeah, that's the responsibility? Just as everybody has a right to clean water. When there is pollution in the water, the water-works and the municipalities and the government need to do something. So when people steal my data is it then me alone against the one who does it? or should it be included in the social security system?

(32:05) There is so much research right now in the technical smart city area. There are already so many technical frameworks for establishing Internet of Things and creating the whole city from technical perspective. But from a social perspective a lot of people argue that we do not have a smart city yet because we have not ensured how we will handle the building in the social sustainable systems into the deployment of these technical solutions. How do you think it can be deployed in the long run? Should people come together and discuss how we do this? People form different areas. (33:04) It's a very very very difficult question to answer. I would say, if we talk about fixing some of the issues then get municipal case workers and employees and policy-makers and a lot of people within the governance bodies to understand what data is. This will be the first step towards actually discussing some of the social sustainable issues. If you look a ODIS, Open Data i Spil, have you seen that? I will send you a link. That's an example of an early initiative on public data. If you look at that list you can see that it's a mix of websites, PDFs, links, and all kinds of different chunks of information. We have to ask people without a technical background what the difference between a PDF file and an API is. A PDF file ensures some level of privacy because it takes a bit of an effort to parse it and compare it, while an API is straight access for good. And understanding that difference is important because if I want to create a company on the basis of some of the different data which is exposed, then it is important to know if I want to use data from a PDF file which is updated once a year and changes format. Nope. When I base by business on APIs, solid good APIs that have consistence and follow a pattern and so forth. Yes maybe. Just understanding that is a huge issue and challenge.

(35:35) To summarize a little bit: When you want to have smart city, a sustainable smart city also from a social perspective, it's kind of similar to an ecosystem, right? You want to create an ecosystem which is sustainable in the long run that runs by itself and you have to educate everybody to be on the same knowledge level to be able to make common decisions that do have as few rebound effects on the long run as possible. (36:20) First of all, the city is an ecosystem I would say. Everyone making a decision on

the Danish digital infrastructure, from NemID to open data, should know on a very detailed level what data is.

(36:45) So that's kind of the first step here - to be able to move on? I'm not making the philosophers kings, it's not making the computer scientists and ICT engineers kings - that would be a very bad move. But just having that understanding of everything digital: what happens when you are on Facebook, why is Facebook different from a public service and so on. If you make decisions on it, you should be able to at least understand the landscape on a more detailed level that the current people do. And I think that would both ensure some sustainable growth but also a more sustainable business perspective as well because companies are very picky on what they invest their time and money in. So if you make a product based on data you want to be sure that the data is the same data from now and ten years forward. The people that make the policy about open data should know that. And if you are citizens that goes through the city with smart phones on, you would probably also like that the rules are in place and they don't change. You know the terms of service when you install a new piece of software, that is updated often. You can't have that in a city because citizens can sign terms of agreement daily because somebody within the municipality changes their regulation. One of the thing that I would argue for, that is crucial for social sustainable digitization, is that there is some level of policy and some level of consistency and some level of transparency.

(39:15) One last question to you could actually link it more towards the focus of our thesis. Do you think it's possible to have a normative model or normative framework for establishing this common mindset. If we talk about data the I think you can not only have a normative model but also have very well-described rules, regulation, best practices, and technical patterns actually. But if you talk about the city then you can't really because the city is somewhere between chaos under some form of control and complete chaos. You can't really control or govern a system that is that big. You can provide services, you can have rules, you can have police and laws, but there is still graffiti on the walls in Copenhagen. There is still people making concerts in the streets. There is still sub-cultures and complaints and sort of messy stuff. That's a basic condition for doing this.

(41:00) So the wickedness is a deal-breaker here? You can not just grasp the whole city as a system and try to generalize it and improve it? Now it becomes almost philosophical. Since you use the word wickedness I assume you are familiar with the concept of wicked problems, right? That is the condition. It's not a deal-breaker. That's just the condition you need to understand. Rittel and Webber (1973) has a very fine description of it and ... has a different description of it, but both of them actually pinpoint some of the things you need to accept and then deal with them. But if we look on a strict open data perspective, I think that is something that is much much easier to both have a technical implementation and regulation and citizens-business centric perspective on it. Actually I think it's possible to write up a taxonomy for open data. You can easily also write up, based on existing work on how to design an application protocol and interface, good patterns for it.

(42:45) And then establish some incentives for actually using such a guideline That's a contract, right? Anders Fogh Andersen make an interesting strategy for talking about contract policy - how businesses deal with contracts. So when you ask the citizens to do everything by digital mail and NemID, that's a very technical transaction contract. And the same when you say to businesses: come play with our data, come and make applications and new interesting companies based on our data - that's also a contract, right? So you can actually make contracts that both reflect the policy, the technical level, and best practices. Which would be super interesting if somebody took the time and looked at it. But that's a different perspective.

Henrik gives us some references to books and contacts and we say goodbye.

160

A.5 Søren Kvist

(00:45) First of all, we can briefly introduce ourselves. We study at Aalborg University, a master in Engineering. Both of us have a technical background and so our master education is about broadening up our perspectives here and see our technical abilities in a broader context. Our master thesis is primarily about how to grasp the idea of open data and how to realize smart city solution, which are based on open data. So that's why Copenhagen Connecting is relevant for us because it seems like a very concrete project and we don't know how much of it has been realized. So we have a lot of questions for you of course. Can you please start by introducing yourself?

(01:48) Yes of course. My name is Søren Kvist and I've been working for the municipality for 3.5 years. What we did approximately 1.5-2 years ago was that we focused on the strategic perspectives in regards to how we could make the city better using data-driven solutions. So that was very much the beginning of all of this. And then some of the projects were launched last year on the open data portal, I think it was September 2013. Open data portal is... many major cities have that now: Stockholm, London, New York, Berlin, you name it. But basically what I've been doing is that I've been working with this strategic smart city projects within the city and then when we did this tender last year for the new street light in Copenhagen, my job responsibilities was: could we use this infrastructure - that street light are - for something else than just the street lights? Because street light are extremely important for the city - that's obvious. What you can say is that what's new about the new street lights is that they are based on LED lamps instead of these old ones and that helps us to achieve our carbon neutrality goals for 2025 because LEDs, as you know, use a lot less energy. My job was to see if we could use this infrastructure for something different than just providing street lights, and that's how this Copenhagen Connecting concept was developed. I might short-cut some of your questions. That has basically been my job the last 2 years; how can we make the city better using digital infrastructure, Internet of Everything, big data, etc. Because as engineers you know that a sensor in itself does not really fit your solution - you need other elements to actually spread solutions to the market and if you have to do that in a clever way, strategic way, you have to take all these different elements into account and make a plan and a roadmap and put a plan up in regards to how all these things fit together. My background before these municipalities, I have a master from the IT-University and also a Bachelors degree in Public Administration, and then I have worked for different companies, public and private companies, before I started at the municipality. You probably know the Journey Planner (Rejseplanen), that's also a data-driven solution.

(04:50) Ok, so this Copenhagen Connecting, how do you see it in a smart city context and how do you want a smart city to be from your perspective? You already had the presentation... It was a very technically oriented presentation as far as I remember. (05:13) Yes, and I can send this new presentation to you afterwards, it's not the exact same and I think it's a good presentation to discuss. What you can say is that our main focus is not really about data, it's about creating a more liveable city because when you use the term smart city,depending on who you are, you will probably come up with at least 10-20 different definitions in regards to what a smart city is. Copenhagen has already won several prizes when it comes to smart city, and it's because we have made data-driven solutions, it has been because we have a good infrastructure for bikes, infrastructure to the airport connecting flights all over Europe. But that's not really what we are working on in Copenhagen Solution Lab, it's more the data-driven solutions for sectors. So the main objective here is not about data, data is the means to some overall strategic goals in the city, and it's all about quality of life of citizens and making Copenhagen a more liveable city. And when you talk about smart cities you should always contextualize it so you know what you are talking about because else it doesn't make any sense because everybody use the term smart city and it doesn't have any clear meaning for itself.

(06:45) No. Does that have a clear goal for you? Yeah, for us the goal is to make Copenhagen a greener city by means of data. (Søren is showing us something from the power-point presentation.) Where It originated from in the municipality was the technical and environmental department, and our main focus there - or one of them - is to look at solutions for how we can reduce the carbon productions in the city. Copenhagen has one of the most ambitious climate plans in the world: we want to be carbon neutral by 2025. And if you want to reach these goals we have some extra challenges because the population increases every second month. So that's two tendencies that are contradicting - population is increasing and at the same time we want to be carbon neutral. So if we want to do this we have to look at other way of doing things in the city already now. One of them is that if we use data in a more targeted way than we have done so far, we can use it to use the resources within the city more efficiently. For example, if you can optimize the traffic on the road, that means that we don't have to make the roads wider to be able to have more cars on the road. So if we use data intelligently then we can use the existing resources a lot more efficiently. So that's the overall vision about our approach to data. Data is not the goal in itself, it's supposed to support the strategy that we already have and one of our main strategies is about the climate.

(09:05) You have a lot of different goals which can be built on top of some kind of architecture, which can be build into the street lights. You mentioned that it was important to bring in public and private partnerships and establish some kind of new institution here. (09:40) Yes. If you look a public procurement processes, how does the public sector buy goods and services, one thing that has been tendency for many years is that you make RFP, describe what you want to have, and then the best company or consultancy they win this task of delivering this to the public sector based on the cheapest price. The problem is that when you have this approach for providing services to the public sector, you don't really take innovation into the whole process because it's very difficult to bid on an innovation process. One of the ideas behind Copenhagen Solutions Lab is that we want to provide this institution where we can have a collaboration between universities and companies so that when we in the future for example want to have new street lights or new bus shelters, or parking display machines, or everything else that actually relates to the physical infrastructure in the city, we make sure that we have the best knowledge and most cutting-edge research in regards to how we actually build a city so that we achieve these goals in a more efficient way. And maybe if just jump to the another slide, because it has something to do with this. What is characteristic in regards to how cities operate in the moment? they very much operate in silos. You have utility companies that focus on the energy sector or whatever they provide to the citizens. The city is very much focused on what their responsibilities are at their department. If you want to look at smart cities you have to look between all these different silos. So that's a cores characteristic in our work – we want to take synergies between these different business domains within the city.

(11:53) That's interesting and it's also something that we want to investigate. Breaking down these silos I guess is one major challenge for you, to be able to harvest the potential value of this cross-sector data sharing. What are the main obstacles in this silo breakdown? Can they be broken down? (12:20) Yes, sure they can. It's a process and it's not going to happen from one day to the next. It's a long process and Copenhagen Solutions Lab is a governance body that is supposed to support some of these activities. But can say: what is the characteristics in regards to how business is being done today? Today there are really no formal institutions that are supposed to make this increased collaboration work between sectors when it comes to smart city. So having Copenhagen Solutions Lab is definitely something that is going to help thinking between sectors and business domains but if you look into the physical silos, there is the whole political agenda. I'm not going into that now, but it's important to understand that when we talk about smart cities - especially because it's not really a term that everybody understands - if you want to communicate this to the people who make the decisions, it's very important to understand that smart city is competing against a lot of other political agendas. That's just how it is. And so, when it comes to projects that politicians can use in their election campaigns, it has to be very clear what we talk about. What you can say is that, regarding the silo thing, the travel department for example focus on optimizing the traffic, the street lights departments they are focusing on street lights, the climate department is focusing on how we can make solutions for cloud burst management. The challenge is that you need an increased collaboration between different business units if you want to make better solutions. Because otherwise you will just build silo solutions, meaning that you will roll out solution for specific business units throughout the whole city and that's not necessarily the best way to do it. It's not that it's not going to work technically, but it's necessarily the best technical solution, and you wont really harvest the synergies between thinking cross-horizontally.

(15:02) So what should the motivations for these different silos be to open up and break down their own silo? what are the incentive structures here that you work with? (15:16) What you can say is that the incentive structures come in regards to what you can actually do when you think smart. (Søren is showing us a diagram with the different elements on an open data platform, such as sensors, smart city dashboard, etc.) The incentive is that some of these elements are really expensive, for example a city dashboard is expensive and these solutions have to work in the way you want them to work and these solutions are not cheap. Of course you can get some of these elements open-source based but if you need to configure them and have the right technical set-up for them to work etc. then they are very costly. Meaning that, when we provide solutions, if we can reuse these building blocks between different business domains - for example a city dashboard then we can provide better solutions and we can provide new insight in regards to making solutions better. For example, traffic control, which is focused on optimizing the traffic, what is very very related to traffic control is weather conditions. For example, when we have a cloud burst, today we don't have a solution that can correlate all this data into the same system. (17:30) That's really a business demand because when there is a cloud burst you want to direct the traffic to the streets where there is no flooding, and we also need to know where to put the pumps etc. that can make water go away. That's a good incentive to why people should participate and that's because we think that we can make better solutions for the individual business domains and if we can just tap into an existing building block, and existing element, and be able to correlate a lot of different data sources for something. Traffic and cloud burst are two examples and when it comes to garbage collection, parking control, there are a lot of different business domains in the city that can make use of components like this. The point is that these solutions are very expensive if you want them to work efficiently and have intelligence built into them, but if we can make these core components and make them available for a lot of different business domains, especially within the city but also the municipality... If we look at the utility companies, like Hofor, they very much work with cloud burst systems to how we can better cope with cloud bursts. So, this work is actually being done together with Hofor so we make sure that overall solutions that should try to tackle problems with cloud bursts, they are not only focused on the sewer system, because that is Hofor's main responsibility where they have sensors, but if we provide additional data on the service level and bring these data into the system, we would be better to manage cloud bursts in the future.

(19:58) Yes. It sounds like you talk about the smart city solutions as a silo within the city. How can we cross the border into the private sector as well? Because you are talking about that you want to use the existing resources more efficiently and I guess there are many resources out there that you haven't thought about. So is it a platform for new ideas as well? A platform for business opportunities? (20:40) Now we are jumping forward and backward in regards to all the different elements that we are working on, but what we can say is that our main focus is on providing some of these core elements that makes out a smart city infrastructure and if we go back to some of the things we talked about in the beginning, open data platforms, we already have an open data platform in operation called data.kk.dk, and that is supposed to provide all this data that we generate in the city already today, but also for future solutions. The idea about open data is that if we provide all this data for example to students or research institutions or companies, then they can build services based on this data. So there is a big business potential in regards to building services for the city or for the actors in the city based on the data that we provide for free. So that's a core element of our work. We don't want to dictate what are the solutions that we are going to build or what are the right solutions to build, but we want to provide the data. Think about Google, think about all this data-driven solutions you know from the international scene, but we want to make sure that the data is being provided so that we can actually accomplish this task in building better solutions and that's where some of these incentives for the private sectors is. If we provide some data and they can see a good business case in regards to building a service on this data, then that's completely aligned with our goals in regards to fostering local innovation and green growth. To give you one example that has been very much in focus in recent years, apps for smart phones that provide a service in regards to where is the nearest free parking space. The problem is that today we don't really have very good data in regards to where are the free parking spaces. But it will provide some kind of sensor solution that can show where the free parking spaces are. If we make this data available for free then an entrepreneur can build an app an incorporate other data, e.g. weather data or whatever, then they can sell this app to the citizens or give it away for free or base it on commercials - that's not really our task, we just want to make sure that it's possible to make such kind of solutions.

(24:05) So we see data as a resource here for further growth. And i guess that you have to collaborate with the private sector to be able to understand what kind of data they need, how they want it published to be able to work with it? Or do you just publish it in a standardized way and publish some data that you think is relevant data for most of the industry? (24:35) What you can say is that the industry doesn't necessarily know what the strategic objectives of the city are. Some of them do of course and know that Copenhagen has a ambitions in regards to becoming carbon neutral. But what they don't know is what data we have available. What you can say is that when we look into solutions that can make these solutions a reality we are going to focus on having an increased dialogue with a company in regards to what solutions they can provide on the different levels. Today we know we don't have enough data for parking, but we know for sure that if we can provide an app that shows where the free parking spaces are, it could solve some of the challenges that we have in the city. To come back to your question regarding how do we actually publish this, how do we use standard and open-source? Our main focus in that when you look at these different elements that make up the overall smart city infrastructure, it is very important to base these solutions on open standards and open APIs so that if you have producer of a sensor, they can just take this sensor and tap it into the existing infrastructure. And then we have the other elements, for example the databases and data analytics, etc. that can be reused so each company don't necessarily have to have all the different elements in place to showcase their solution. So it's very much focused on open standards and open APIs. When it comes to this whole discussion about open-source it's not really our main objective here, because that's a completely other story - that is about business models etc. and we don't take ownership of all this, so that's very important to understand. Open standards are a necessity no matter if you want to base your solutions on open-source or something else.

(27:20) Let's try to go a little bit back. You mentioned that you work with the triple helix mindset and you want to be green and sustainable, but doesn't that require that the citizens are involved as well? Yeah. What you can say is that at the moment we have looked at a lot of technical solutions in regards to how to solve the city challenges. And that is because we haven't really established the right governance structures etc., but since we are doing all this for the citizens they are the key expert in regards to what they want. One of the main objectives of Copenhagen Solution Lab is to support citizens, so we don't build solutions that the citizens don't need, but to be able to do this it is important to understand that Copenhagen Solutions Lab is only 4 people. So this work that we are going to start up now is going to bring these different institutions together, for example the research institutions, in regards to make solutions that are viable that people can accept. But now you will probably ask how we exactly are going to do it, and does that mean we are going to make focus group interviews? (29:06) Just to make people understand what they will get out of this collaboration. Yes. And that is actually what we are discussing with other people from Aalborg University, because they have a whole department, Techno-Anthropology, because that's basically what they specialize in: how can you see the development of cities and the whole collaboration between technology and sociology. But that's now really a technical discussion, that's more about how do you see development from a social perspective when it comes to technology. And that's a field called science and technology studies primarily focused on the scientist Bruno Latour. You might want to look into him because he is very much focused on how you see technology development, and that not something that we necessarily can make an RFP on, we should really look at all the people using this technology. If they are not provided with the right technology, people will not use it or they will use it in an unintended way. But that's another discussion and not something that we are going to theorize on in Copenhagen Solutions Lab. We are going to make collaborations with the people that are expert in this matter for example from university. And your background is Civil Engineering, right?

(30:50) Yes. But we also try to open up a little bit for these kind of social perspectives because as we see it, so far we have a lot of technical solutions, and a lot of cities have such technical solutions for a lot of different smart city problems, and you can also see contemporary research with big frameworks for enabling Internet of Everything and so on. But it's difficult to find any concrete data-driven solutions out there. (31:37) Yes. We can go a little bit over time, if it's okay with you? (Søren is finding some slides that explains his point.) (32:16) Two things. To take the more technical questions first, you are looking for concrete solutions, you are probably aware of the open data platform that exist all over the world, but the expectations to open data has not really delivered actual solutions yet. And one of the main obstacles is that the data we have and to provide for students and companies is simply not enough. It is not enough just to open up our system data from the city, we have to provide real-time data, because it is especially when we provide real-time data that you can actually make solutions that are interesting for business and entrepreneurs to build data-driven solutions on. And we simply don't have enough data for that. So that's one element in why we don't see all these solutions on the market: the data is not interesting or good enough. That's one element and then another element that is related to that is that open data is one thing, but Copenhagen Connecting and our projects are not only focused on open data because a lot of this data that is necessary for making solutions for the citizens is not open data. It's simply not possible because the data is too sensitive. It's energy data, it's about the exact flow of traffic within the city. We have some data sources that are necessary to make the solutions work, but we cannot provide this data for free because it's too

sensitive. One of the solutions that we work on is smart-metering together with utility companies but we don't want app developers to make an app that can show whether your neighbour is home or not, but we want to provide this data for the individual citizens. It's very important to make a clear distinction between open data and more privacy-related data. If we look at energy data, what we can do is to aggregate some of this data on the building level, and anonymize this data so we will be able to make some of it available as open data, but it should never ever be possible to relate that data with an individual person or individual household.

Then there is another element relating to the last part of your question. When you make solutions, from a technical point of view it's not because the technology doesn't exist today. But, for example, when we talk about intelligent trash cans that can tell when they are full so we can optimize the collection of trash, that's a good example of a technical solution we know will work, but when we provide this service who wants to use it, for example the people working at the waste department, they might mean that they have to work in a completely different way than they are used to and that takes a lot of processing in regards to the rational choice on what is the best thing for the environment and for the city and for the municipality, but a completely different element is that how are people actually using the city and how are they used to work and that are barriers that relate to institutional theory it's called: People doesn't necessarily act in a rational way, but base it on how they are used to do things, their values, their routines, etc. You probably know from your private life or your school life that you don't always do your task the most rational way but it's probably based on a lot of other elements, and those elements are the exact same when we talk about smart cities and citizens. One thing is that we could provide a lot of technical solutions but if these technical solutions are not going to be used by the citizens and if they don't like the solutions, they are not going to be a success and to make sure that we don't roll out solutions that are not a success, we are going to make collaborations with people that are experts. It could be citizens and other key stakeholders in the city, but it started this week so we haven't tried to make formal agreements yet. We have been discussing with other departments from Aalborg University that specializes in these kinds of things.

(38:03) This is also what we want to come into in our thesis and we saw on LinkedIn that you are working as Enterprise Architect. In Enterprise Architecture (EA) you work a lot with breaking down silos and maturing the collaborative mindset of an organization. And I guess that you can also talk about maturity on a smart city level. (38:40) Yes, but I'm not aware if there are any smart city maturity models as we have maturity models for a lot of other things. But you are very correct in how EA is about thinking out of the silos. It's about reusing elements between different business domains, and what I've actually done is that I've used these EA tools and deployed them on a city level. That's how we look at the smart city.

(39:10) That's interesting for us because you see the city as a big system which can be optimized and that is also what we want to investigate. If that makes sense or how to start with that kind of optimization. It's more easy to see how you can do it on an organizational level but on this big system, a city, how do you use the EA thinking in a city? And how

do you normatively mature each part of the city and make incentives for breaking down these silos? (40:03) I think it's an extremely good question you are asking and I'm not sure that I can answer it completely because that's basically why we made this whole Copenhagen Solutions Lab. That's what we are going to focus on. We want to make sure that all these different players in the city have the right incentives to actually collaborate for making these solutions. So I cannot give a concrete answer on this. But what I can mention to you is that some of these solutions that we've been working on are all about having a good argument, basically. For example when we talk about smart metering, if you focus on the solutions, what are the kind of solutions that we can build if we think cross-horizontally throughout all these business domains? There are some national initiatives in regards to make smart metering of power. You are probably aware that Dong wants to make a new power supply in Copenhagen, but from a citizens perspective the city don't want to roll out solutions that are only focusing on one specific need. So if we are successful in our work we hope that we can make an increased dialogue between these different players in regards to utility, so that the usage we roll out to the citizens they will not only be able to collect data on power but also be able to do smart-metering on water, gas, etc. And that's where the city plays a key role because if it doesn't take this role, the citizens will end up with having more different solutions, gateways, and more different apps on their smart phones depending on what kind of utility you want to tap in to. So that's the rational, good argument for why people collaborate. There are other examples in regards to what are the more incentive-based arguments and that could be for example you could tap into the existing infrastructure so you can roll out solutions that help different players in the city in a more cost-efficient way. And you can correlate this data between the different players depending on what the nature of the business domain is. For example Hofor are quite interested in getting data on the street level when it comes to water, but the street of Copenhagen is not really Hofor's domain but the city's. So that is an incentive for Hofor to be able to control the sewer system better if they get some data and have close collaboration with the city, then they can better manage a cloud burst. And then when you look at what kind of damages those cloud bursts cost that's really expensive, also for the insurance companies etc. Now we are just starting up, but of course there is a high incentive for insurance companies to make these solutions a success, because that will mean that the damages caused by cloud bursts will be a lot lower because we will know where there are humidity problems, and one can see the damages in real time and they can do things to try to minimize the causes of the damages. And that's a good business case for the insurance companies. So that's another element of an incentive that could be interesting to further explore. We haven't gone there yet.

To get back to what are the incentives, another element is the network layer. As you might be aware of, it has not been possible for the public sector to provide WIFI for tourists because we have something in Denmark called kommunalforvaltningen and they basically decide what are the responsibilities of the public sector, and what are they not supposed to work with. And providing WIFI and etc. that's not a public sector task. (44:52) So this is a regulation bottleneck? Yea. It's more principles than actual regulation that dictates what the public sector should focus on and what the public sector's tasks are. What has happened in the last six months,

actually during this summer, is has already been decided that the public sector will be allowed to provide WIFI for tourists and why would that be a public sector task? It's interesting because when you look at who actually owns the infrastructure and earns the public space - that's the public sector, with the street lights and so on. Why would we do this? We wouldn't do this just to provide WIFI for citizens but we can use the same infrastructure for a lot of purposes, for example traffic management and cloud burst management. That itself could be a good business case. Then if we can provide WIFI for tourists that could be a good service to attract more tourism to the city. And then we can go back to the question: what could the incentives be for telecom companies to participate in this work? And that is that there is an increase in demand on bandwidth when it comes to mobile devices and the solutions that the telecom companies work on now is that we have a 5G 4G... there is a lot of emerging technologies that can help us to solve this problem. But one of them is the standard of Hotspot 2.0, which can switch seamlessly between wireless network and normal GSM network. If we do provide these hotspots, that we want to use for other purposes, we can provide this service for the telephone industry. So for example when there is Distortion Festival in Copenhagen where the 4G networks always breaks down we can provide this extra capacity to the telecom industry so their system doesn't break down and the citizens will not get disturbed. This is not about providing free WIFI for everyone but providing a service to the telecom industry so they wont have to set up additional masts etc. So that's another incentive. this might seem very theoretical, but this is actually what has been done big time in the states (USA).

(47:53) It sounds like you will provide a very scalable infrastructure. So when a new technology comes in ten years, then you are also able to deploy that somehow? Yea, that's the whole idea behind the smart city infrastructure. Of course you want to make it scalable and as open as possible on all the different elements that makes up the complete infrastructure. That's not only about networks, but it's also about open standards and open data etc. It's all about making things as open as possible.

(48:34) We would like to talk a little bit more about using EA on a city level. I guess that as an enterprise architect one of the things you can do is to mature the whole organization as a system on the same time to get an agile mindset throughout the organization. It makes sense that you can use a maturity model as a reference model to be able to establish some common goals and also show how one department will be able to fulfil some goals and work more efficiently if they think more horizontally. If you do that on a city level there are some main actors that you have to involve. You represent a public actor or a kind of cross-boundary actors. There are some more high level public institutions that I guess you also need to involve in this maturing of the whole city to be able to think horizontally. (49:50) Of course we are working with EA when it comes to solutions, but when it comes to a city-level there are some key stakeholders that we are already in dialogue with at the moment, and that's especially Danish Industry (Dansk Industri). They are key stakeholders representing the companies interests. Then there are some other institutions, public agencies, for example the Ministry of Cities and Urban Planning, Ministeriet for By, Bolig og Landbrug, they are also a key stakeholder in this. And then we have lot of collaboration with CLEAN and Copenhagen Capacity. There are some key network and cluster organizations that represent the segment of the people using the city. A lot of this work is going to happen through those channels, they have the expertise in regards to how to reach out to their members and the people they represent. And also of course how do we include the citizens in all this? So that's to answer part of your question in regards to how do we actually mature this. That's the process that we are having right here, that's what we are going to start up here. What we have focused on so far is: what are the solutions that was possible? What is value of these solutions? You have probably read the socio-economic analysis we have done. We have to actually make these solutions operational within the city we need this triple-helix organization that can actually make sure that this dialogue is happening and if you put this kind of organization within the city of Copenhagen, it's not really the best place because it is triple-helix and supposed to have increased collaboration with a lot of other players in the city. It's better to make a satellite construction that can support this triple helix in a better way. (52:20) You talk about maturity models and a lot of detailed questions about how to exactly do this. For a city level I don't think this there is a maturity model, but I know there are some... There is a very high-level abstract model, which are not action model. No. I know Boyd Cohen has made his smart city wheel. There are different tools you can use to measure how carbon neutral a city is and so on. But they are not really action model systems. Søren is showing us a Prezi presentation where a lot of the thoughts are put into EA terms and models. You probably know a little bit about EA. It consists of a lot of different elements and the maturity model is one of these elements. You also need migration plans, you need to define the whole scope of this project, you need to define your vision and strategies, what are the IT principles, what are the work processes, because one thing is technology but you also have to start to work in a new way if you look from the municipality side. You need all these different business units, for example within the city, but also universities etc. And you need new work flows and you have all the use cases in regards to smart metering etc. etc. And the you have all the technical elements and that's actually what EA is all about - how can we align with different layers, strategy, business, and technology, in a more aligned way and apply it on a city level. That's of course a very ambitious task and it's not something that we are going to accomplish in just six months because it's an ongoing process but it's also how EA is used in companies. (54:50) (Søren is showing us how their reference model works). We have a lot of strategies and these strategies should be aligned in between the strategies because some of these strategies are supporting the other strategies.

(55:55) Actually you can say that you use EA as a big framework? Yes. EA is not the goal, it's the framework that we use to put all these different building blocks into the right elements. And now we talk about who are the key stakeholders, who the universities are, who the companies are, who the citizens are, and EA has the tools that you can use to orchestra all these different elements when it comes to strategy, business, and technology migrations plans, risk analysis, overall business tendencies, etc. And this is one example garbage. If you have garbage collection, you need new work process and then those elements correlate with a lot of other elements in this EA framework. Maybe I'm getting too technical now but the mindset is about

reusing existing components because if we don't do that we would have to do all these silo systems but we can reuse them between business domain. And of course our first goal is, within the city of Copenhagen, to handle cloud burst together with Hofor. So we are not planning to roll this out next year, this is an ongoing process that can take years - that's very important to stress.

(57:30) I guess you can see this maturity also from a more behavioural economics perspective. Because there are so many stakeholders here that are not aligned with the same mindset as you, they cannot see the exact benefits. You can of course explain them the benefits from such a presentation for example. They probably have a motivation to go into such a collaboration all these different stakeholders. They also have a social motivation because it's very socially acceptable because it can make them more legitimate and so on. But they are not able to do it. (58:30) Yes, that's a big challenge. Because who has the resources to collaborate with this? what are the incentives? What you can say is that now you talk about behavioural economics, which is a little bit different from rational choice theory, it's not necessarily the same thing. This is another way of looking at the world and how it's working. You talked about a lot of these incentives to why institutions should participate. Are they able to participate from maturity point of view? And that's a good question, we haven't found a solution to that yet. But what you can say is that what we are doing right now is that we are talking with different agencies, for example Danish Industry, to discuss with them what we want to do and if we can get their support and tell them that it's something they want to participate in - you would also need to use some resources and deliver some resources to this project. Because otherwise you will not be able to do these tasks. But smart cities and this horizontal thinking is one thing that is happening also within these agencies in itself because they have the exact same challenges. Danish Industry consist of so many different businesses but they are going to start up the exact same work in their organization in regards to how they can take care of their stakeholders' interests between the different business mindsets. This is not something we are doing solely on a city for the city of Copenhagen, this is something that works in synergies with these existing activities that are already happening within these smaller agencies that we are working together with.

(01:00:32) Yes. Okay. So when you use EA like that it sees the city from a systems perspective and system optimization perspective? Both yes and no. Because if you look at EA and how it's used in companies, it's very focused on IT. But when John Götze made the OIO EA^{25} he was not solely focused on IT. He was focused on all the different elements that you need to think of when you make solutions. You mentioned if this doesn't exclude some elements, and my objection to that would be: no I don't really think so because it would take too long time to go through all the different that make up an infrastructure or EA framework, but it gives you a toolset to actually put these different elements, that could also be behavioural economics, into this way of thinking.

(01:02:35) **Ok. So this can actually function as a generic model?** Yes that's at least what we are trying to do. But of course it can be complex to communi-

 $^{^{25} \}tt http://arkitekturguiden.digitaliser.dk/oio-ea-metoden$

cate, so for ourselves it's a toolset we are going to use to make sure that we have thought of everything and know who is working with what. For example we have an increased collaboration with universities but we also know that we cannot work at all the universities in the exact same manners. Some of the universities are better at something. But to give an overall picture about who is doing what and who is working which challenges. Are we talking about incentive challenges, then we might have a collaboration with Aalborg University and that would tackle some of these governance challenges and this was we can correlate and get an overview in regards to are we taking care of all the elements, which should...

(01:03:48) **That's very ambitious.** Yea but you have to understand that this is not like we want to necessarily dictate about how this is going to be but EA is a tool and that's also how it's used in the private sector. You can't always align to an EA plan and roadmap because the business needs change form day to day. Sometimes something happen and we have to change some elements. But then again if you don't have an idea in regards to where we want to go, and if you don't have an overview in regards to all the different elements then it's very difficult to make these changes in a agile way.

(01:04:40) One last question. Do you think it makes sense to put in a maturity in the lower layer of the EA framework? Yeah. To be completely honest with you I haven't worked with maturity models recently, but I know that it's something that you often discuss in an EA context. Since this is very ambitious and we should do this for the whole city and we can't really make maturity models for all the people using the city I don't think a maturity model is the first we we are going to focus on. But we are definitely going to focus on citizens involvement. But a maturity model is definitely something that could fit into the governance way of creating a roadmap for a smart city. If you want to make a roadmap you also need a maturity model to find out how fast can we progress. If you want to change the way people work with technology within the city of Copenhagen, we cannot make an overnight change just because the technology enables this, but the people working with waste and garbage they are not mature enough to use this.

(01:06:14) Exactly. So there are some contingencies in this to be able to reach some kind of smart city level. Then there are some factors that need to be fulfilled to be able to go on an work with this? Yeah. And just to follow up on your question. Maturity models for measuring digital readiness that's an ongoing process within the city of Copenhagen where we have a lot of resources allocated to it. So there are people working at the city side working on how we can make our employees more digitally aware and ready and mature and understand benefits. But that very much in the silo of Copenhagen, and I just want to stress that when you talk about maturity on an overall smart city level, I think it's something that we are very much inspire by Boyd Cohen. He made a smart city wheel where you can benchmark how mature the city is when it comes to mobility and other elements. That's more like a benchmark and when you talk about maturity models you should be very much aware of how do you want to use it? what is it used for? etc. If I knew that we were going to talk so much about maturity I would have read up on it, but I think it's a very important topic and it's very good that you look into
it. It's just very important for me to stress that our main objectives with this EA is not to dictate how the city is going to work in 5 years time. But it's a toolset that will help us identify and make sure that all elements are being taken care of. And if we work on a certain element is is because it has been prioritised.

A.6 Lasse Steenbock Vestergaard

(04:35) Hi Lasse, good morning and thank you very much for your time. I am Mikkel and here is Santosh as well and I guess you can see us in a moment. I guess we do not have that much time so just to start, we are master's student from Aalborg University Copenhagen and we are doing this about how to harvest the value of open data in a governance context and so, we were referred to you by Martin Brynskov from Aarhus University and your profile looks very interesting for us, of course, and we can only find information about you in website from Alexandra Instituttet. So, can you please introduce yourself and tell us about your role in the Alexandra Instituttet and about this smart city Lab? (5:50) Yes, definitely, first of all, are you in the wireless connection? (5:54) Yes, we are. Ok, so would it make sense to not have the video on then because it is lacking a little bit on my side. OK, perfect, first of all I am located in the smart city Lab in the Alexandra Instituttet in the Aarhus department and until now, I have been our open data guy and I have been involved in quite a lot of stuff around, Denmark, specially in relation to open data. I have been one of the main tech guys in the Open Data Aarhus Platform. I have been in the technical lead in the open data platform part of Ehrvervstyrelsen. They have just launched there open data platform, few months back. We have been advisers for Copenhagen before they made there open data platform. We have been advising Odense, which are, as we speak, creating a open data platform. We have been advising Silkeborg Municipality, Aalborg Municipality and so forth and we are just travelling around the country just talking about open data and smart city and at the moment we are also involved in the ministry of By, Bolig og Landdistrikter (Ministry of Housing, Urban and Rural Affairs) (07:30). I don't know what English term is for that. They have a smart city network and we are a part of that as well. So, we have been around, quiet a lot around. And this also broadens across borders because we are also involved in lot of EU projects, which means that we are having quite good relationships out in Europe and in general. We are also trying to promote open data where ever we can, out there. So, that is more or less my role.

(08:14) Yes, that is good enough and it is nice to hear that you are so much focused on open data and smart cities and we want to ask you in to this. So, why is open data so necessary for smart city? (08:29) There are different reasons and I would not say that I am particularly focused on open data necessarily because I think open data is good for something but it is not necessarily that good for other thing but we can always talk about that, but all in all, the reason why open data is good is of course from municipal perspective is transparency. Obviously, because you can say in simple example, if tax payers can see what there money are being used to, I think they are more willing to accept the choices being made. I guess just having transparency all in all gives you more comfort I would say. So, other reasons for having open data is also for empowering citizens, so that means citizen themselves would be able to go in and have a look around - what data do they have in our municipality or another municipality or just around the country. Can I co-relate different kinds of data from different municipalities, can I find new insights and can I even create new services for myself, which I have been missing when I have been walking around or living in a city or have I seen issues that other people might have and I want to help them out. So, sort of having this citizens empowerment without focusing on the bottom line that you need to have (10:13). So, we have seen quite a lot of that, citizens have, around Europe specially, involved and also States actually, that citizens have been making this (10:24) small Apps, which has no business case at all and you know SMEs would never have done this kind of cases or Apps because there is no money in it. So, that is one interesting part of it. Stuff that do not have any money value can still have value to people and by having open data we are actually able to having this non-profitable entities being made anyway. For instance, in Denmark we have this lady, I don't know if you have heard about this. She have made this app both on a smart phone but also on a web page where you can find the nearest toilet. It is really simple and you know there is no money, there is no value proposition. She just want it because, may be she needs to go to the toilet quite often or she have small children or stuffs like that. You might actually need to find toilet nearby so that is one of the, for me, major benefits of having the open data. (11:33) So, that's a kind of welfare effect in it. Yes, that's a good way of putting it and if we look at more like statistics, We have, for instance, the Mckinsey report before years back and other similar institutions have created similar value propositions. So, they are saying like, open data will be able to annually add, I think its something about 3 billion dollars of added value in the society. I don't know how they actually measure that but all in all what they are saying is, open data will have huge impact on our future societies, in different aspects.

(12:21) So, how do you ensure that these data are utilized that they are strategically developed and they will be used in some way as we can go to for example data.virk.dk and there is a lot of data here, how is it agreed on or decided that this is the data that is going to be published? Who do you involve as citizens, you say that citizens can be empowered by open data but how do you involve them and how do you involve business in to this? (13:01) First of all, actually, the data.virk.dk that is the one we made actually. But of course, we have only made the technical part. So the content, Ehrvervstyrelsen did by them self. So, I would say if we look at the picture on a European scale, I think its about half a year back I was in a round trip in Europe and there I focused mainly on open data and the public view on open data is that regular people don't care about open data because they don't know what they can do about it and open data is extremely low on the political agendas, all over Europe and this essentially also goes in Denmark but I will still say that Denmark is one of the leading countries, specially in Europe, regarding open data but we are still in a really early stage and you can also see that if you look at data.virk.dk or data.kk.dk or oda.dk. They have data but its not that great data. For instance, its mainly dead files, it could be data about a municipal meeting from 2009 and who attended that meeting? It's a crap data and that is called static data. May be that is more political way, I put it but they are trying to up the value or the quality of the data. That means, having real time data and have it in structured format so that you can use the data directly within your apps because you have this API access so there is computational access to data or automatic access to data. So that is happening but that is going really slow and that is the first thing. So, in relation to how citizens are involved in publishing of this data, I would say we are not there yet. All the institutions that publish data are trying to involve citizens but it seems that the main issue is not necessarily the citizens. It is not even the technology. It is within the municipalities themselves. So, they don't even understand open data themselves. I was a part of, in the very beginning, the Open Data Portal in Aarhus, where we actually tried to get access to data, so that means we went out to the different departments within the municipality and said: we want your data, can you please help us and tell us what data do you have? And at that point the departments were extremely conservative. They actually did not want to put out their data because, first of all if they put out there data they do not know what can happen. Secondly, they did not think that regular people would need those data, that would not make sense to them, that was just boring data and the third point was that when the departments did not know what people could use the data for, they extremely fast got protective. So, for instance, they got some confusions that if regular people can see our daily work then they will be able to criticize us about not being efficient and stuff like that. So, I think they are actually, still here in Denmark, focusing on the organizations themselves and have the public organizations themselves (16:58) and how they can, you can say, make the mind set around open data internity but the next step of course is to involve citizens but I would say that its not because they don't involve citizens because they do but citizens are being involved in a different level in a sense that, for instance, Ehrvervstyrelsen, Aarhus and Copenhagen, they do have this Hackathons that means they bring data sets somewhere and they have some cases and invite people and then they want to have this debates and discussions and at this Hackathons regular people can actually ask: OK, do you have this data? Could you make them public? And then the municipalities could actually go back and try to put out the data and they actually do that. But you need to build your fort before you could actually start to develop it further.

(18:03) It seems like that a lot of the value in open data or opening up data between institutions between sectors actually lies in this aggregation of data of the different sectors or institutions. So, how do you establish incentives for different public, private parties to participate in this open data development and governance to harvest that kind of, not just the data itself, but the value of aggregating it? (18:41) I think, quiet often when we talk to people about open data we quite fast get in to this aggregation of, lets call, arbitrary data or data across sectors and that is people can quite easily see the value in that. So, if we can begin to look at data that we have never looked at before and when we try to merge that we will be able to have new knowledge and even within the municipalities, not only municipalities, within the public sector they are already today aware of: if we could aggregate these two specific data sets we would be able to get completely new insights, but they can't because of legislation. So, I would say that the mind set around that and the value in aggregation of data across sectors that is already quite prominent and obvious and I would say that mind set is actually quite developed but quiet fast people just through the towel in the window (19:59) or whatever you call that in English and say: OK, I can't handle this because now we are in the area of legislation and that is so $\dots(20:08)$, so lets not just do it at all.

(20:14) That of course complicates, a little bit, that of harvesting the value of open data in that way but lets try to go little bit back and say how...

It seems like smart city as a concept is very much focused on sustainability and creating long term welfare. How do you think open data can contribute to that sustainability? (20:48) So, the established relationship between citizens and municipalities today is that citizens see municipalities as service provider and the municipality also sees themselves as a service $\operatorname{provider}(21.15)$ and that means that whenever, for instance, a light bulb is broken in a lamp post, it is the municipality that essentially should notice it and its also municipality who should fix it. So, when we talk about smart cities and when we talk about sustainability, sustainability also comes in to the area of: OK, How can we jointly do stuff and how can we be more like an organism? City so, should be an organism. So, that means everyone should essentially be able to help everyone. That means the citizens should, first of all, be able to give notifications to municipality about this light bulb. so that part is, a sort of, actually already done in Denmark because they have this services like, something called like ...(22:12). So, may be citizens should actually also be able to change the light bulb. This is, I would more or less call this a metaphor because it might be a little dangerous actually. Conceptually, people should be able to participate in their own cities and do stuff more actively and I will say that open data can help quite a lot here. Well, first of all, you could, for instance, say that what if whenever you as citizen create a notification to the municipality about this light bulb that is broken, that message could be put on the open data platform so that could be broadcast to every citizen and you know the citizen that made the notification might not have the competencies or equipment to change this light bulb but lets say we have an electrician living near by. He has the time anyway because I don't know it's evening or I don't know. He could then actually go with his ladder or whatever he might have and his knowledge and he could change that light bulb and he could then put that notification in the system saying I have now fixed it. He might also be able to do some advertising of his company there. (23:38) But is that open data? Well, I would call it open data because if you have this, lets call it community platform where, everything that is posted to a municipality is posted to broad public. We have, for instance, in Aarhus they have this, what they call them, telephone reports, so whenever a citizen calls municipality, that is registered and then start up an internal case on whatever that request might be and these data, for instance, not open at the moment but they, well, so, they have tried to do that. That means on the Open Data Aarhus Platform, they have an excel file from like 2011 with some of these data. So, yes I would definitely call it an open data.

(24:26) It is interesting that you say that we should kind of see the city as an organism or as a system, I guess you can say, that means we have to strive for kind of mutual understandings of each others need. All the actors in such an organism has to understand that if I produce my data, I will actually get some value back. What are the obstacles in maturing the city in that way? (25:09) So, the obstacles for educating the people to give away their data? or No, I don't think it like people but its more like all the actors. To create this mindset in the actors that if they give something away they will potentially get it back again because I guess that is also what we have heard before that there are no real incentives for giving away or using money on giving away data and don't know if they will get it back again somehow but it will optimize the organism. Right? (25:51)

At the moment we don't really see those good incentives if we talk about revenue like money coming in but I would say we have, for instance, back to this find nearest toilet and in my opinion that is an example of actually added value to the organism or system if you want to call that. But another interesting thing that we have found about lets call it human logic is that if I ask you, can I install an app in your phone? what I do is harvest whatever I can from that phone from all your sensors, that means from you microphone, from your accelerometer, what do you have, luminant sensors, you would probably say no but if I instead ask you, could I install an app in your phone where you are able to figure out whatever, so lets say you want to buy a new train (toy train) whatever, you can just tap that in to the phone and the phone will immediately give you the ten cheapest place to buy that train. It will even show you can, the shortest trip to it. How you should get there? Should you take your bike now? is it raining so you should take your car. It gives all that kind of information or it can even be simpler. So, all in all if I instead of saying I want all your data If I say "should I provide you a service?" you would say, yes and I would say, OK but I would really like to have your data that is being created behind the scenes (27:50), Is that a problem? You would probably say, No. So, in that sense we have a wake moral to say. If the service is good enough, we are willing to whatever it takes.

(28:07) So, this sounds very much like public to citizen relation. How do you involve the public sector and what about the business here? To make it sustainable in the long run I guess you also should have the potential to get in to the market. Yes, definitely and that is where we are struggling at the moment because we are still in the really emerging phase so we haven't seen any goal business model at. I think we have one company in Denmark, as far as, that at the moment trying to make money out of open data and that is, I don't recall the name of the company but they do these minecrafts maps of Denmark. I don't know if you have seen it. (28:52) I think I have heard about it but I didn't know it was a company. I think they are called Geoboxers. It started as, as far as I recall, some employees at Geostyrelsen (29:14), they created this minecraft maps over, where was it? was it Copenhagen or something like that. And I think it got some kind of attraction because Geostyrelsen paid for it but after that they stand out as a new company called Geoboxers. I think they are like three people or so in Geoboxers and at least 2 or 3 of them like the CEO comes directly from (...) (29:45) and they are are trying to make business of these open data that Geo (29:53) put publicly January this year but I actually do not know how well is going for them but it is an issue and what we can say at the moment is that we are still at the very beginning, that means we are still building the foundation and you can't really make a proper business before you have a proper foundation because as I said earlier, we don't really have that good data sources on the open data platform in Denmark. so, that's one thing but the other thing is, we don't really have a professional pipeline. So, that means we might have a data set that is real time oriented and you have API access to the data source, all is good, but essentially the open data platform or the data provider will not, at the moment, guarantee like a 100 percent of time. And if the data sources can't be trusted completely then you as a company would not make a business out of it because you don't know, well lets say the data stream goes down tomorrow, then your app or service will also go down and that is not trust worthy.

So, those are the some of the issues we are experiencing at the moment but we are continuously getting better but its going a little slow, as to speak.

(31:19) Don't you think that is the reason why government bodies are not really interested in this open data platform that they are not sure about if its going to be successful in the long run or there is no incentives for them to invest so much money it. Don't you think that is the reason? So, that is partly a reason but at the same time when we look at, in Denmark all municipalities are always in competition for all reason with each other. I am not sure if I get that but it means that, for instance, now that the Copenhagen and Aarhus has the open data platform, all the other municipalities are scared and they think, OK, we need to do the same otherwise we will fall behind. We don't know what it does, we just need it. So, that's one thing but another thing is Municipalities shouldn't have and don't have the same incentives as the private sector. So, that means direct money outcome. Well, of course its also of their concern because Municipalities do have companies within there domain but for them it could also be better citizen service or happier citizens, .So, in that sense they are not necessarily focusing on the money only and that is why open data is also directly relevant for municipalities but there is actually one concrete example of why municipalities would benefit immensely from open data platform and that is, I do not know the English term, but when citizens or journalists or whatever, they applied for (...) (33:09) but you do? Yes, We will translate it. OK great, so, whenever citizens does that it starts up a whole like a huge procedure within the municipalities and its ridiculous. So, that means we have one citizen writing an email about this (...) (33:29) to someone down in the system and this goes all the way up to the mayor. so, they have to go really conservatively through all the layers of the organizations and then up to the mayor and all the back down and then they might internally agree on something and when they have agreed on something one employee should go in to files and provide that (...) (33:54) to the citizen and this is like it takes so much efforts from a daily work that a municipality is doing and in Aarhus and Copenhagen specially, they are getting this quest quiet often. So, if lets say the municipality could put all their data, well as much as possible on an open data platform, they could save so much internal resources in saying in the future whenever a citizen says we want this (...) (34:25), the employee of the municipality can say directly, OK, just go in to that web page. you can find it there.

More generally it sounds like you say that you can use open data as a means for public business process re-engineering 34:46) Could you elaborate a little bit? It sounds like there are some pretty rigid business processes inside municipality for example, which can be actually by means of open data they can be broken down and optimized. Yes, precisely that is what I am saying. So, if it was up to you and if we talk about one of these municipalities that just want open data platform. What is the ideal approach in your opinion? So, when you talk about ideal approach that is how do you create the best open data platform which actually can bring some values to the citizens and the municipality." Yes, so, first if you look at Aarhus and Copenhagen, they have chosen a little different approaches and I think to your question

(...) (36:10) lets say different parallel. So, when you look at hoe to make a quality platform in relations to having trust worthy data and proper data. in Aarhus what they did was, they just traversed the entire municipality, went to all the departments asking for data and all the departments said , well, more or less, lets do it and what they did, what they do, they then provide an open data platform with excel sheet and the department say we are now transparent. What Copenhagen did was instead, they started out and they also been initiated from within the technical department and they have then only focused, until now, I am not sure if they have broaden there scope but until now they have been focusing only on the technical department. So, what data do we have within the technical department and this means that they, as far as I am concerned, they have little bit better quality data. it means, for instance, they have both real time data and the API access but they also have the direct access to the internal databases. So, that means they actually have relatively good pipeline, so they can in that sense, you can say, offer relatively good quality of the data. I am not sure if you could say the up time and that kind of quality is optimal yet but I think we are not that far away from companies actually being able to use that data. So, that is like on one level an I would say in that case it seems that there might be more, lets say, immediate success in focusing on a specific department and try to see what they have and may be even a department with good data source like Geo data (38:14). OK, so if we talk about, lets say, more from governance perspective or lets call it from political perspective. So, what happened in Denmark until now is that they have been using (38:29) approach. So, it means that some leader down in the system thought that this was a good idea and said lets just try it out and see if we can go a little bit on to the radar and see if we can get data from here and there and you know it sort of works but it goes quite slow because then different department they don't have any obligations, they don't have to give their data, they don't necessarily understand and so forth. And their are some uncertainties and we could quite easily go in to some (39:02) and so forth but if you take it the other way around, if you only went from the top-down. That would definitely be easier. I know, for instance, Odense Municipality has done something like that in the sense that they few years back decided that whenever they get new software of any kind they have a disclaimer of contract saying, I think something like, all code and data that belongs to municipality or the broader public, something like that. So, that makes stuff really easier but I would say that it has to be a combination of top-down approach and the bottom-up approach because if you only have the top-down, you don't really engage the grass roots or the eco-souls (39:53) within the municipalities. So, if you have a combination of, this has been decided from the top-down that we are focusing on open data and we want as much as possible to and if you have this, Lets call it bottom-up people that in my opinion and experience is the best way of doing this.

(40:18) So, just to recall what you have said, its important to make the public sector understand what is open data and what the benefits are of open data and in that way getting them in the same level as the market and as these idealist, which can come up with the bottom up approach. So, how do you think you can educate the public sector? So, that is also actually where we are sitting at the moment. So, you can say that lot of stuff is happening automatically, lets say specially like the teenagers of today, they are posting wildly on social media. So, I guess that mind set is already emerging. So, its

just the elderly people or people from 30 and above that really don't have that mind set but I think its easier. But the more technology we get and the better services we get, the more reluctance disappears, I would say. But in other way we are trying to educate the public is by actually trying to create the events of different sorts, for instance, having this hackathons and there is also this data drinks concept. It's both here in Aarhus and in Copenhagen and also around Europe. So, trying to you can say awareness and we have also seen that what makes real impact here is whenever you have real success stories, which is not just like a power point success story but a real Geo that means like a proper service. It could be the find nearest toilet. i would say that the find nearest toilet has not got that much uptake but having these concrete cases, real life cases, they are really really strong. And they are difficult to find at the moment. Yes, mainly because of the quality of the data, you can say and also because it is hard because its just like the hen and the egg, the problem here. So, if the quality of the data is not good enough you cannot create anything but if you don't understand the data its really hard too because I guess you need to work from both sides. you need to have a better quality of data but you need to also get a better mind set for the better understanding of what you can do with the data.

(43:20) Don't you think it contradicts a little bit with the rigid structures of the public sectors and the public institutions because they are so much put in to different silos with different departments and different ministries and so on with no incentives of cross broder thinking? Precisely, and that is one of the main issues today. So, it is not really technology and I wouldn't even say its the citizens. It is, I think you hit the nail, It is definitely about both the mindset in the municipalities but also the organizations because in Aarhus, for instance, they have 200 different IT systems. So, they have 200 silos. Its crazy and of course its way worse in Copenhagen and that is one thing and that is on technical level but it goes exactly the same for the department . People can do stuff in parallel even without knowing it and they are.

(44:40) So, is there any or do you think there could be, if you should brainstorm a little bit, anyway to handle this instead of making this hackathons and so. Do you think there is a more kind of structured way of breaking down public silos? So, when we are talking about this hackathons, we are mainly addressing citizens. So, the hackathons we had until now, we have of course engaged with public sectors but we have more like, the hackathons has been initiated by the public sectors. So, in that sense the public organizations have been more like facilitators. They just showed up and provided some data. So, its on their premises. Yes, you can say that but stuff is happening within municipalities. In Denmark if you look in to Copenhagen specially and also Aarhus, they are trying to do from within these horizontal set ups. So, for instance, in Copenhagen they have just created the Copenhagen solution labs, which is municipal department, where they have like physical building somewhere and something like (...) (45:59) supply something something. Actually, I think we went there to do an interview. So, that is one of the interesting approach because this way what they do is, they actually try to assemble people from different department within the municipality so they can sit physically together and hopefully, they will talk together and figure out that, well

we are doing stuff in parallel and well we can actually collaborate in this and they are doing exactly the same. In Aarhus we have something called dockit, which is like a new citizen center at the harbour, where we have library and all that. They have a whole, i would say, a huge office room where they want to put in a lot of desks and each department of municipality of Aarhus should have one member sitting down there more or less constantly. so, they are trying to built horizontals but its going slow and its happening.

(47:01) OK Lasse, I just have one question, in your point of view how do you define smart-city if you see from the open data perspective? Ya, from an open data perspective, I would say its like, a smart-city, I would say its like an organism where everyone essentially has the possibility to both, sense what's happening but also acting on what's happening and actually being aware that you are able to provide impact on your society. ya, I guess it would be something longer line than that but I haven't gotten the question about how I define smart-city in relation to open data, before.

(48:24) And also you said that municipality wise they are trying to develop open data platforms for example in Copenhagen and in Aarhus. Do you think they have put it in some level of standards so that those platforms are interoperable in the long run and may be in the long run they can create an open data platform that can serve for the whole country? So, when they are creating the platforms in Denmark, they are using CKAN and that is developed by the Data.UK, which is located in london and its quite few years older but one of the main thing about this CKAN platform is that you can create a lot of small CKAN instances or servers around the country. So, each municipality could essentially have there own and they make sure to harvesting or getting data from there own local areas and one of the features in CKAN is that you can harvest meta-data from other CKAN servers. So, that means we can have a national CKAN instance or server, which essentially can just harvest all the other CKAN instances and it can harvest all the meta-data and you can have this single point of entry for open data in a country. So, that is one of the main features that CKAN platform have. So, that is already, we have already in mind in developing these platforms.

We don't have any more questions now Lasse and that was very interesting to talk to you and our thesis is about if it makes sense to make a maturity framework for a smart-city as well as you see with lot of organizations for example from an enterprise architecture point of view , you have a lot of different maturity frameworks, which gives a guideline to create a level mindset between the actors in an organism and we want to see if it makes sense to have such a platform on a city level and kind of collect data about what such a framework should include. Ya, that's sounds really interesting thesis and I should say if you get really succeed in this. You should start your own consultancy and you will get rich really fast. We realize that and we also realize that its more complicated them just a framework of course but that's the part of the learning process and I think lot of you inputs can actually help us a lot. So, thank you very much for talking to us Ya, I don't know how. Are you going to use this, Are you going to transcribe this interview and use it in your thesis. Oh, sorry we forgot to ask actually if it was OK to record the interview. Ya, it is and you can easily, you are allowed to mention my name and all that and you don't have to make the reports not public or anything. Its all about open data, Right? Thank you very much and yes we will transcribe the interview. But whenever you are done with the report please send it. Yes, We will contact you in couple of months hopefully Ya, OK good luck and thank you. Thank You, Bye

A.7 Ville Meloni

Hello, Mikkel! (01:23) Hello, Ville and thank you for talking to us and taking your time with us Ya, my pleasure. And so we have between 45 minutes and 1 hour, hopefully that is enough. We are two persons here, Mikkel and Santosh, and we are calling from Aalborg university. We are doing out our masters thesis right now and collecting data for it about open data governance and that's why you are so interesting because you are doing this very concrete project in Finland it seems and so, to get started can you please introduce yourself and tell us about your work with this Forum Virium and your role in it. Ya, and thanks for the questions in advance. I work in Forum Virium Helsinki and I have worked here since 2010. From 2010 to the end of 2013 my main role was to start this Helsinki Region Infoshare open data in Helsinki Metropolitan area. So, open data is basically what I have been doing from 2010 and I was there a project manager and then after 2013 to start of this year, basically as planned, the Helsinki Region Infoshare operational responsibility was handed to the City of Helsinki Urban Facts, who was the owner of the project from the beginning. So, basically turning open data from pilot in to sort of business case (3:23). And since January 2014 I have still working in Forum Virium Helsinki but now as a program manager. And I am one of the project manager working for the thing called "The Six City Strategy." Its basically a collaboration of the six largest city in Finland for the next seven years to be more open, to help companies, different organizations and cities to collaborate based on open data, open innovation platform and sort of open collaboration methods. So, my job there is to facilitate these strategies forward with my colleagues. So, still dealing with open data but in a little bit different scope and context. So, that is basically my background.

(04:21) All right, it seems like you are taking a very holistic approach to this open data governance by incorporating business and different cities as well in your methodology you emphasize a lot, it seems like when we read in your website, it seems like you emphasize sustainability a lot that it has to be long term solutions that you end up with. So, how is open data contributing to sustainability and what is open data? Ya, good question, I think open data is, if I start with that, its a way for different organizations and individuals to collaborate concretely. For example, in analysis or creation of digital services or just sharing and understanding. It's something concrete. Its like a fuel for these things. And if I think the cities from the public sector perspective, I think, one of the thing it has enabled is this, quite traditional organizations which might work in silos, it helps them to collaborate and it helps them to understand each other and helps them to understand how they function because they look at the data and they get different perspectives from their data from outside and from level of (...) (06:01). It has lot of functions but I think the more and more the public sector and the whole society is digitalised. We are talking about data and data is everywhere. Google and Facebook knows everything about us and they have the data from us (my data). I think the role of data is getting more and more emphasized and one of the problem has been that in the past and now less of course is that the public sector has a lot of valuable data but it has been locked and now when its open people can actually use it and do different things. And of course at the log run to help businesses and to help people understand how thing s function and also I think, very importantly to help the public sector bodies to look at their operations and how they could perhaps stream line (7:00) them and so on. And sustainability, I think it depends how you define sustainability. I think, if I look at, there are lot of sort of things that you can do with data, lot of understanding. You can optimize things better, you could sort of share more, you could collaborate more and you could sort of... I guess its also a way of learning. So, I don't know if you mean the environment by thinking of sustainability but I guess there could be one aspect that open data could help in the future, but how do you define sustainability? how do you see it?

(08:00) That's also a good question and we are not very narrow in our mind set regarding sustainability. We see it as a term describing how to sustain our current amount of welfare in to the future. That's a kind of very broad definition but how do you think, OK it seems like you emphasize that open data can open up for transparency among institutions but the thing is how do you establish incentive for actually participating in this open data mindset development? I think its in a situation where the mindset is not very open. Open data is something new or something so hostile or danger (09:12). When I look at the past, it has taken lot of time to built the trust that open data will be useful. I think in the past, the many data owners have felt, the first thing that came to their mind is that there is lot of dangers related to open data and something might go wrong, the data is not perfect, you make legal mistakes, you loose money, all these bad things and I think it has hell of that with those entities that we have been taking very small steps to open data. And in some good cases to show that, OK, it has been useful to the society or useful to themselves and then its easier to take bigger steps when there are more and more good examples, it becomes a sort of less and less scary and more like - hey, we should also do this. Now, I think in Finland, specially in Metropolitan area and also in whole Finland we are in a stage where, its less we talk about: should we open data but we talk more about what should we open and how can we accelerate this and what can we do with it. It has taken time and patience. So, its not something you can say right away, hey does this make sense.

(10:44) It sound like you are a bit ahead of us. In Denmark, in terms of how you can establish a collective mindset among the smart city actors actually? Even that question of how should we publish it or what should we publish? It seems like we are not quite there yet. So, we want to try to find out how you can accelerate such kind of collaboration in a smart city. In 2010, there was a open data movement in Finland(11:43). This movement in Finland was very small. There were only handful of people enthusiastic about it and we looked upon the US and UK and said: OK they are so much ahead and I think what has happened here is just, we have been lucky after there was this commitment from the city of Helsinki and other cities: saying lets try this. So, that also probably encouraged this open data enthusiastic and probably encouraged the Finnish government and other entities and it grew the open data community, if you can call it that. It has grown bigger and I think its organic in a way. It has taken time and there has been a lot of good individuals and I guess enough of(12:40)that has sort of now come to a point where many people are talking about it but I don't think there is a secret formula. I think, there is a test somebody has to do or certain entities have to put commitments to do something concrete so that it make sense and also invest time and sort of communications and develop with developers and with people from the ecosystem. Not from the traditional IT companies or not only them, but also people who are enthusiastic about it and just try to look at it as a kind of..., (13:21) where you look at this ecosystem and you try to help different actors to understand and to do something concrete. So, it just takes time and good people and some money.

(13.35) But if you should point some actors, who are the main responsible actors for actually taking an initiative to do something with the data and to kind of mature the rest of the actors and think about how to harvest the value of opening up data? I think it has been the cities. In the beginning, Helsinki and other metropolitan cities took the step to invest time and money in starting open data operations and concretely opening data, that's one thing and then at the same time the Finnish government, I think it was after 2011 December when the national... (14.36) in Finland when they were allowed to open, really big time, this geographical data. After that, that turned out to be a very positive thing. So, I think that also encouraged some other governmental players to do it. So, I think its the public sector players who actually invest time and money to open there data and I think its not opening data for opening data in the sake of doing it but it should also take care that when new IT systems are implemented (15:16) to make sure that there are this open APIs by default. So, lot of education and lot of active communication is needed about these and in the end then trying to make sure that it is also in the end being mandated and there can be even, you know (15:38). So, these kinds of things and of course the companies you have, lot of these open data development in the beginning is from grass roots level, you have individual level at first and then you have smaller companies doing something and then you have some well established IT companies who understand that this open data is good for their business because they are selling this, for example analytic tools and the more data there is, the better. So, I have seen a lot of companies even in Finland; multinational, they have played an important role in actually helping the ecosystem to understand the importance. They have their own business interest but it has not been in conflict and then there is also some other companies who might be negative towards this open data and loosing business and those are the companies that have based their business on closed systems. And I think lot of the things Forum Virium has done with other cities, other entities, concrete stuff around transportation data, around kind of citizen feedback data and all these makes very concrete stuff and I think it needs only couple of good apps, then open eyes of decision makers: OK, now I understand it, the open data. I am not saying the apps are the whole truth. I don't think there is lot more to it but those has been a sort of, over the past years those have been the eye openers. You know, you just invest the time in focusing on some open important data then you encourage developers, you arrange competition and try to increase the standards in what can be done. I think all this activities is to get there. So, but you asked where the main players are or the driving force is?

(18:04)Yes, also all this sounds like a very straight forward value chain that you publish some data which independent developer can use and they can

spread out some applications which end users benefit from but it sounds like they are more into it if you talk about an open innovation platform, which is sustainable in the long run you also have to incorporate it in to the market as such. Yes, I think we are moving in Finland, at least sort of, when I look at it for example this year there is sort of discussion moving from, still really important to get the data open but its sort of... I think there is a field it will happen that. It might take time but how the discussion should move towards, how do the government and the municipality work together in standardizing the data, making it more useful. What is their role in enabling or building software based on open data. To what extent do they add value to the data themselves - public sector and where do companies come in? What is the role of public sector in actively opening the data and using it to create and enhance their own service with less cost and before what is the kind of role of existing a new IT company in this equation. And this is kind of a next discussion and it becomes more difficult because at least in Finland, there is a big problem, there are over 300 municipalities and there is the government and the data in the systems of these municipalities are not interoperable. So, its one thing to get the data open but if it does not work together then from the business point of view its quiet costly to, you can develop an app that work in Helsinki but it does not work in other cities or in the government then it does not make sense to develop. So, it should work across large cities, across the nation and hopefully across European Union and world. So, I think the interoperability of the data and the data quality and I think then their is a big role for IT companies and other companies actually talking the data and making it in helping the government and other data owners to make it more interoperable. And then another question is also, what is the role of the peoples data, what is the role of company's data and how you can make better analysis and services mixing all this data and who provides these services. So, this are the kind of discussions we are having now and looking forward at the same time opening more data making sure that the new IT systems actually we have, have some standards and open APIs. So, this is kind of....

(23:01) When we read about this whole issue, at least from a Danish point of view, the Danish government has put down some researchers, which actually found out that there is actually a lot of value to be harvested from opening up data, cross-sectoral data and aggregating it somehow and by that breaking down the silos of the municipality and the government and It somehow is contradicting with the structure of the institution at the moment, the way they are split up, different departments with no incentives for collaboration. So, can you elaborate a little bit more on how it can be done from a practical point of view? Yes, that's exactly the finding, I can say that's not easy. When these organizations are used to work in silos. Its in their like organizational culture to focus on one thing from their perspective and then this data, hell of sense opens the eyes: OK, I can look at this from 5 or 10 different perspectives and everybody, I think many, understands that it make sense because then from the sort of first eve view, if you take this things better into account its more sustainable. You do less of the same or you keep inventing a wheel in (23:21) less. But it also means that you need to collaborate and then take a lot more things in to account. It's very painstaking at first because you need to agree on how to do this. I don't have an answer on how it will happen on a larger scale. We have some experiences from lets say, harmonizing this or kind of helping some organizations to collaborate on the data but we don't have a large scale experience in like what happens if you try to do this across several city agencies and different municipalities. So, what I am doing now, we are in the start of that phase. So, I think it is (...) (24:14) everybody understands, this make sense in ... (24:19) but its problem for me, for my organization. So, I think there needs to be some kind of incentives and keep the performance indicators. Lets say that if I now collaborate and open my data, I will some how benefit from it concretely. So, its kind of management issue and its kind of more like a how do you incentivise. It take strong leadership, how you in depth incentivize these different silos to actually collaborate and how to built that? But how to do that, I am not an expert yet. I think its also, you start small, take kind of entities that are sort of you have individuals, you have organizations that really need this and see the benefit and really do invest the time and then you experiment with them and then share best practices before you take any thing to large scale.

(25:27) It sounds like incentives need to be economically driven somehow. I think economically driven in the sense that lets say you got the average public sector, body or organization and its duty is to serve the people. People (...) (25:53) to do and there are very little people, there are people but not every body is just very adventurous or wants the experiment. So, normal people, the civil servants they need some kind of economic benefit in the sense of meeting a target, saving, being able to serve more people with less money, that's always a very good motivation or just plainly saving cost. So, I think in terms of open data one of the learnings is that, since we started in 2010 there were 3 assumptions. One was that there will be economic benefits for the companies. There will be benefits for the citizens in terms of more transparency and thirdly there will be benefits for the governmental public sector bodies because they actually can improve their operations and I think this is still the way to go. You somehow need to create incentives for the public sector who open the data to benefit from it immediately and to benefit from cooperation. And one thing is that if they can by providing open data drive down their IT costs because at least in Finland there is lot of vendor lock-in situation and there is lot of money being wasted. So, this is one very good way to go, I think, but not the only one.

(27:25) But to summarize what you say, is that to be able to reach a long term goal you have to set up some short-term wins as well. Yes exactly, when we start..., I think its in Finnish but there might be something in English as well. In 2011 we created strategies for opening data and there were lot of recommendations, I think over twenty, and handful of key strategies and one was of course you should take the low hanging fruits, so quick wins that are easy to understand. At the same time, in terms of what to open, you should not just open data that you think is good for business but you should just open large kind of, different types of data because you can never know because its open innovation. You can't really know how somebody is using that but it helps to create new angles and new sort of innovation based on new ways of mixing different data. So, we have that in mind but definitely quick wins, if you can find quick wins and concrete use cases that you know could be solved, I mean some business problems that could be solved by doing something

with the open data then you should look at those and that's partly what we have done and partly what we are planning to do in the future when we build this in a large scale with this 6 large cities is to think of also some business cases. It may be related to transportation, may be related to health care and so on. This is kind of good approach.

(29:13) Do you get support from business and other actors from actually connecting cities because we have interviewed a lot of people from Denmark and they actually emphasize how cities in Denmark are competing right now. Instead of thinking cross-city they just make their own kind of data silos now. Do you understand? Ya, I think that's exactly what we are aiming right now. Its kind of unique in the sense that in terms of open data we have reached a point where its not just a Helsinki and metropolitan area but its also other large cities, which also have developed open data portals but are on individual level and have collaborated for some time. These cities, they believe that they should definitely collaborate on the open data area. There are probably some IT companies who tore around the cities and they might say, hey you should do the opening in the same format because it benefits and is good for everybody. There is some of that and that is very good but that is not the driving force at the moment. How I see is, these cities, they actively decided to work together strategically and to invest time and money on open data making it interoperable. There is the competition aspect of course between cities but in the open data, may be I am being naive, I think its not an obstacle instead its more an opportunity at the moment and I think all of this 6 largest cities are looking forward to actually do this together but I don't know how it turns out in 5 years time. But I hope everybody agrees that Finland is way to smaller country to not to work together at this level and also, they work together with the government and other municipalities. I mean there is just no other way. So, we are not competing with each other in terms of open data at the moment not at all. We are trying to help each other.

(32:02) You write on your website that one of your goals or the overall goal of open data initiative is that cities will be better equipped to respond to future challenges and promote sustainable urban development and this responding to future challenges, it sounds like that the open data will have the possibility to make cities more agile. Ya, that's what it says, its true. So, how is that? OK, the logic is that in a closed system whether its closed data or closed source, which is not sharing information, the idea is that its very inefficient. In the future there is lot of challenges, there is less money, things change more quickly, there is digitalisation. So, you need to be more agile and we believe that one of the ways for that to happen is to open up your processes, open up your data and collaborate and work together. And that enables hopefully cost savings, better services and that also hopefully enables reacting quicker to whether it is citizens or company needs instead of being very closed and not cooperating. Thats kind of fundamental idea behind this. And what is sustainable urban development in that context? Its not like one of the thing. It has a continuity. Its a smart way of doing things now and in the future and that it can actually not just involve the traditional way, you have the city and civil servants versus companies and the citizens (34:22). But that they actually form the kind of ecosystem. They

form the cities. So, that is being viewed as a sustainable development of smart cities in a sense so, I think that's way to do it (34:46).

(34:47) So, in your point of view, How do you define smart city then? Ya, i know there are many ways to define smart cities. I can't say I am a smart city expert in the sense that I will define it from this certain angle but smart city I think its the kind that enables different entities: people, companies, organizations and creates a way for them to collaborate and then provide, you know, whether its technologies, whether its data or whether its kind of whatever it takes for the citizens and actors to work together. So, you have people and you have technologies and you view people as enabler. Less about the traditional way of viewing, I don't know if its traditional way of viewing smart city that you have smart grids or you have surveillance system and you have this large IT systems. We think it more like, city as an enabler also for cross routes development and just enabling people and organization. Come up with ideas and enable them quickly to utilize those ideas and turn those into action, to data and to different enablers. This in a way and you have actors that look at city as a ecosystem and try to, you know hell different entities, you don't have one hand or you don't have like one IT or you don't have some other things but you enable innovation. You say rather 'Yes' then 'NO'. Thats kind of (...) (36:51).

So, you mean the citizens have to be smarter to build a smart city rather then technology and other things? Yes exactly, I think technologies are needed but the idea, the wisdom is not within the government or IT systems but its within the people. So, the people really are the possibility and we should enable more and more people whether they are individuals or whether they are companies or whether they are in different organizations, train them to participate and help to build a city because the city is not formed, city is something that all these organizations (37:38) take part in and I think traditionally, it is a problem that lot of the innovation capacity of these people and entities, its being wasted because there is not the mechanism to interact, for example in building services for the city or whether they are other services. It has lot to do with how you involve people and how you. I think one of the examples I have is, do you know the Restaurant Day? NO. OK, there is, just a moment, I will send this link in the Skype, hold on. Some years ago in Helskinki, somebody, just people, they came up with the idea of having a pop-up restaurant for a day. You know just, lets make a restaurant for a day, anybody. And I think the first reaction from the city of Helsinki was: hey you cannot do that because its not healthy and you need this license and so on but now it has turned out to be a big big thing not just in Finland but it has spread across multiple countries. Its not in Denmark yet but I know in many countries, you have this Restaurant Days. Its basically, anybody can make their own pop-up restaurant, people come and they just let. We have this internet service, they just let people know what is my restaurant about, how do you find it and what is there? And in Helsinki alone I think there are 100 of these pop-up restaurants and there is 2 restaurant days per year. So, if you think of it, it does not require technologies and it is super. Everybody is looking forward to it and its now like instead of city saying NO, you can't do it, the city is saying, Yes, its great. you know, everybody is happy, it is something fun, something interesting and might even make business sense, good for tourism, and the city, all it needs to say is Yes. And now even the city of Helsinki is marketing saying this is the place, where the Restaurant Day was sort of created. So, this is just a very ordinary example that you know this is smart city. It just allows people to do things, you don't necessarily need any technology. Ya, that make sense.

(40:38) When you work with sustainability enabling technologies or thoughts you have to consider if they are sustainable in the long run and you have to consider the rebound effect in the long run and doesn't that require to incorporate all the actors in the decision making while doing any decisions about holistic open data initiatives? Ya basically, I guess it is the trick of everybody being able to say what they want and need and then just something happening and (41:34) deciding something. You might argue that doing this what we are doing and with open data, you can't always make sure (41:43) when you have open innovation, you don't necessarily know if it leans to sustainability. You also take risk, you can't really know if something is not working then I guess you should be moving into something that is working better but just the point is that the open data, it can be good or it can be bad. It can be anything. Its like Internet. Like, is Internet sustainable? How do you answer to that. It's something that is there, it will be there and the way we use it then I think is the question whether it is sustainable? I think it is same for data as a part of digitalisation. I mean you have data, data needs to be somehow computed and it needs to be transferred etc. In a way it is a new generic enabler, this open data.

(42:45) It sounds like that your approach to it is a top-down approach. Initially, a top-down approach where you provide a layer over platform for a bottom-up approach to grow Ya, I think that is well summarized. So, you need both definitely. You can have, like this restaurant day is a good example. It is a bottom-up approach and now it is encouraged from the top. But this open data in Finland, said there was a small cross route movement but definitely, it was in a sense top-down approach that the cities or the data owners decided and the mayors decided that we should do this. But their sake of doing this was to enable the bottom or the other players to do something beneath and so, in a way top-down approach to enable bottom-up approach.

(43:46) It sounds like it and I had one question that I forgot. Do you have anything Santosh? Yes, I have one question, You said that the initial approach should be taken by the public sector in opening up of data but don't you think its also the responsibility of the private sector to create some incentives for the public sector to participate in this approach of opening data? I think, Lets put it this way that one of the expectations from the public sector is that the private sector actually makes use of it. So, in a way that automatically should motivate some of the private sector players to also encourage opening more data by using it, by creating something useful to the end users. And now when more and more data is open, people are looking if there are new businesses and what is the role of businesses and so on. So, they play a big role whether or not they are able to utilize it but as I said in Finland how it started, it did not really originated from the private sector. I know in some cities or countries, where actually it was this large IT companies went to the cities and said we provide this open data service for free but that didn't happen in Finland. I don't know if I answered your question, I wonder. But they have really big role, the companies of course, and I think when it comes to the question of like what is the role of public sector in terms of opening and providing of data. Where does it end and where does the private sector come in and the other thing is what is the role of private sector in providing APIs to their system, to their data? How to then collaborate using that with the public sector and with individuals so they can see huge potential there and that discussion in Finland is still in early stages, when we are talking about private sector and opening their data or providing APIs in general. I don't know how that is in Denmark but we are in quite early stage.

(46:54) Also in Denmark to a big degree and we haven't talked that much about the involvement of citizens. Do you take citizens in to consideration when doing for example this six city strategy? Yes, when it comes to open data, all this cities have, more or less some open data activities meaning people looking (...) (47:28) to open the data. They have some open data portals and the ways to provide citizens the mechanism to, you know, let them know what kind of data should be opened and developer meetings, different topical meetings you might have, for example we have had city planning because you don't have such thing called citizen. There is citizen who knows how to code, there is a citizen who is interested in city planning, there is a citizen who is interested in health care whatever. So, what we have tried to do and are now actually this 6 city strategy is providing extra effort to make sure that in each of these cities and also nationally that we can provide more and more help to these different groups who are interested in utilizing open data and working with this entities who have opened the data. Community managers, developers meeting, topical meetings and so on and also these mechanisms for these portals and other things that when somebody is doing something and want more data that cities have. Opening that data and trying to do this in sort of a collaboration providing all the methods (48:56) and formats. So, this is a kind of a extra kick we are looking for.

(49:02) That makes very good sense. And I wanted to ask something. While you are thinking. I have one thing, while looking at you questions about this open data platforms. One really tricky question is at the moment is, since the cities they have their open data platforms, they are mostly now this kind of meta data portals, CKANS and such where you not really host the data but you just link to the data source. The question is to what extent do the cities need to start creating a common data warehouse for example in terms of being able to standardise and harmonise the data then, what then? I mean where does it end up and where do the sort of companies come in and the central government. So, I don't know, Its not going to be a easy discussion. I mean whose role is it. So, some of those thoughts. We have prepared some financing for doing that for the sake of standardization but then in sort of when it gets more serious when you actually host the data then from the businesses and the level of personal citizens point of view, you should actually be responsible for it. You should provide acceleration, you should sort of take it very seriously and so, to what extent are we able to do that? then that is the question. But this we should be able to do it together.

(50:47) So, at the moment the concrete and tangible results of your work

is data somewhere or APIs. Are we able to find it somewhere, your published data on the Internet? If you say mine, I will refer to this Helsinki Region Infoshare. If you go to, are you familiar with Helsinki Region Infoshare? Not really. All right, I think I have some. I will send you a link here and luckily we have also invested in creating stuff in English, like our planning and best practices. Here is one, so its http://www.hri.fi/2years/. It is basically website and a publication you can download, which is from last year but I think it very well documents of how the things were developed in Finland and not just in Helsinki but in whole Finland and kind of ecosystem angle and very concrete examples and so on. And then of course if you go to, http://www.hri.fi/ (52:10), this is the data portal of the Helsinki Region Infoshare and we have, there are 1100 data sets and there is I think close to 100 applications that developers have created and there is discussions and there are comments and so on. So, that's very concrete and that is also of course not the (types something) Its actually very concrete in compare to Denmark All right, http://www.avoindata.net (52:44), this is built by the community. I went at that. It means opendata.net, so that is based on the stock overflow system. Its a kind of questions and answers regarding any open data issue trying to aggregate it all into one place and then take this in to a (\dots) (53:01) in to this different data portals into the future and so on. Then I think just to show you the scale, I think its fantastic because you have this different Facebook groups and so on but in the Helsinki Region Infoshare facebook group you have 10258 likes, OK, but then we have this one https://www.facebook.com/groups/fi.okfn/ (53:28), Finnish Open Data Ecosystem facebook group it has 2500 people, that's quite a lot. And there are more sub groups, there is sub group for like governmental open data for open municipalities, for data (53:44) journalism e.t.c. So, these are kind of pretty active and I think this organization, I don't know- Do you have open knowledge in Denmark? No. So, this we have in Finland. Its a big entity now, The Open Knowledge Finland, its based on the international open knowledge foundations kind of members, originates from the UK. So, that facebook group that has 2500 people, basically its the group of this Open Knowledge Finland facebook group. So this open knowledge Finland is a big entity, open data sort of entity, which kind of functions more kind of volunteer basis. It facilitates the usage of open knowledge. it has lot of working groups to deal with transparency issues with open data business and so on and its very active. But it was only established in Finland 2 years ago or 3 years ago, I can't remember. (54:58) But it is with the actors from the whole ecosystem? Oh yes, like individuals, Forum Virium is a member, you have companies as a member, but its the whole ecosystem. And then we have of course, we have this (...) (55:18), which is really good, now this year in Finland. Its now the fifth year I think and 135 submissions based on open data. So, this is the year we haven't (55:38) yet organized. We have many events in different countries but in Finland I think its growing better and better. And so, this for example is co-arranged by Forum Virium Helsinki and Open Knowledge Finland and this third entity. So, there is lot of collaboration. Open Knowledge Finland also help different entities to collaborate and then we have lot of joint things. I mean, these are some of the players in the ecosystem.

(56:11)) It seems like one of the core things is to be able to built business models on the top of open data. Is that also part of the discussions now

in here? It is. We have business models, in larger sense, you might have in a traditional sense by making money or just by providing value and those both should be taken in to account. So, how can open data and open knowledge provide value? I think that is the bigger question. If you talk about really business business, we have for example this (...) (56:50). so, this is like, in English it is like data refinery. So, its about how to, let me see if there is anything in English. Ya, there is actually. I can send you this link (...) Yes. I keep bombing you. yes, do it, its very nice. Hold on (typing) I think if you look at the Open Knowledge Finland and different working groups, it has a lot to do with this but (sends link) this is in Finnish, I guess but its, also this ecosystem is not focusing on the governmental open data but also my data. The concept of my data that we as an individual would control our data and then how to combine that with private and public data and there is also the discussion of, as said, with this data refinery and these companies on how to get them evolved in actually opening there data and collaborate. So, this is what Open Knowledge Finland is in, what Forum Virium Helsinki is in, this is what the some part of this different cities and governmental organizations are working together. So, it is just not open data but it in general how to sort of use data and you know, the kind of digital technologies to improve the life of citizens and so smart city.

(58:53) And it seems like a collective way to develop the mindset of everybody in the ecosystem. Yes exactly, its kind of I would say. I was just discussing with my friend and again I think this link I will sent to you. If you read, I think, one thing, this should be this one, (...) (59:15) which is in English and sort of documents quite well even though its bit old its not too old. But I was just discussing with my friend that in compare to UK, I think open data there is very, a sort of, far ahead but it has been more like, OK, lets put couple of millions and make sure open data business is happening and this open data institutes and everything and its being very high on the political agenda and so on. But in Finland it has been a kind of, may be a bit slower but more organic in the way that this ecosystem has developed. We have of course done our part to help to built the ecosystem btu its more like, I would say more in a sustainable basis compare to when you just have a government agenda, lets open data, 1 million, and there is a new government and its not sustainable because there is no ecosystem, there are no really people enthusiastic about it. But now in Finland, I would say we are far at this point. I think we have the people and the ecosystem who really want open data and they have idea about how to use it and they sort of know how to interact. So, kind of fostered smart people as well, you can say? Again, I wouldn't say we have smart people but I think we have helped smart people to utilize their capacity. We have helped them to find each other. We have helped them to, may be, come up with new ideas, to network them and then to inspire it. Other then to inspire this governmental bodies and I think that's one of the learnings that if you helped this different people kind of developers, civil servants and others to actually meet and interact, it might be scary at first but when they learn from each other, you know, and actually sees that this is beneficial then that sort of happens. You need to help whether by arranging workshops or whether its by arranging competitions or whatever, just discussions and communications, that's really important.

(1:01:25) It has really been a very informative interview with you and a

very good look in to how you do things in Finland. You do things in a kind of more matured way, we would say then the Copenhagen Municipality is doing. Ya, and it has been very interesting and , we do not have more time but thank you very much for talking to us. And Ville, I forgot to ask if its OK to record the interview. Its fine. Its probably easier, I am sometime, I say very long sentence. thats just good because we will transcribe the interview to see if it makes sense to drag in some quotes from you and I guess it does. So, thank you very much. Thank you and let me know if there is something and let me know when this report comes out. Ya, we will do that definitely And thank you again. Thank You.

Appendix B

Interview Guides

B.1 Interview Guide for Kristoffer Hvidsteen

- Can you please introduce yourself?
- Can you please tell us a bit more about the job in Accenture and your role in Accenture.
- How do you define Smart City?
- What is the link between sustainability and Smart cities?
- What is Accenture's interest, as a private sector company, in dealing with sustainability?
- How can open data contribute to sustainability?
- How do you establish incentives for different public/private parties to participate in the open data governance and development?
- What do you think it needs for the implementation of a platform for sharing data between the public and private sector? Who are the actors involved?
- How do you ensure that your open data solutions are economically viable/sustainable in the long run? Do you make them scalable?
- Do you find it important that decisions are made in agreement across the whole eco-system?

B.2 Interview Guide for Søren Møller Jensen

- Can you please introduce yourself?
- What is your role in Copenhagen Capacity?
- What do you think are the most important organizational barriers for establishing an innovation platform based on public and private data? What are the most important factors for overcoming these barriers? (Because you write in your report that it is a technical challenge AND an organizational challenge).
- You distinguish between direct and indirect value creation when writing about the realization of the big market potential. What do you think is the biggest hindrance for unleashing the potential of indirect revenues? Especially the indirect revenue that 'open data' can contribute to.
- What is the biggest challenge for Copenhagen Connecting to be successful? They have a big emphasis on creating an innovation platform (with much of the indirect revenue that you write about). How to overcome these challenges?
- Is CCC's 'Big Data Infrastructure' facing the same challenges?
- These projects, which establish infrastructures for further smart-city initiatives (with potential for many derived values) seem to include a lot of stakeholders from the triple-helix, who have to have a mutual understanding of how to utilize the infrastructure. Does it make sense to talk about smart-city maturity among stakeholders?
- Do you know about IDC Government Insight's smart-city maturity model? Would it be beneficial for a smart-city to have a reference maturity model for assessing stakeholder's maturity levels and thereby be able to make smart-city initiatives, which every stakeholder can understand?
- Influence of the PSI-directive. Is it limiting the possibilities of reusing data for innovation platforms? Denmark has not made any changes to that.

B.3 Interview Guide for Henrik Korsgaard

- Can you please introduce yourself?
- Can you please tell us a bit more about the your current research in smartcities?
- How do you define Smart City?
- Can you please tell us about how do you deal with different private and public sectors? What are the main obstacles?
- You have identified that a certain framework is missing in the conceptualization of a smart-city what are the main considerations while developing such a framework? How is generalization beneficial?
- How do you define and explore the readiness of a smart-city actor to provide data for a service?
- How do you establish incentives for different public/private parties to participate in this data exploration?
- How do you define Social Sustainable growth?
- While developing such a system, do you also consider the economic viability of such system?
- How do you ensure that your solutions are economically viable/sustainable in the long run? Do you make them scalable?
- Do you find it important that decisions are made in agreement across the whole eco-system?

B.4 Interview Guide for Søren Kvist

- Can you please introduce yourself?
- Can you please tell us a bit more about the job at Copenhagen Connecting and your role in Copenhagen Connecting?
- How do you define Smart City? What do you think we need to make Copenhagen a Smart City?
- Getting in to the topic, can you please explain us about the Big Data Infrastructure that is under discussion among different Public, Private and Academic organizations?
- Can you please tell us about how do you deal with different private and public sectors? What are the main obstacles?
- How do you establish incentives for different public/private parties to participate in the CC governance and development?
- Copenhagen Connecting seems already to have established a technical infrastructure. What are you doing to get the market involved in using the infrastructure/architecture and building a market on top of it? What are the main obstacles?
- What do you think is the main factor that should be emphasized or put maximum focus on while developing a linked open/big data platform?
- How do you ensure that your open data solutions are economically viable/sustainable in the long run? Do you make them scalable?
- Do you find it important that decisions are made in agreement across the whole eco-system?

B.5 Interview Guide for Ville Meloni

- Can you please introduce yourself?
- Can you please tell us a bit more about Forum Virium and your role in it?
- How do you define Smart City?
- What do you think is the role of open data in Smart City or How can open data / open services contribute to smart city?
- How can open data contribute to sustainability? What is the link between smart cities and sustainability? Why is it important?
- Can open data be a game changer in developing sustainable business?
- How do you establish incentives for different public/private parties to participate in the open data governance and development? What are the main obstacles and necessities?
- What do you think it needs for the implementation of a platform for sharing data between the public and private sector? Who are the actors involved?
- How do you ensure that your open data solutions are economically viable/sustainable in the long run? Do you make them scalable?
- Do you find it important that decisions are made in agreement across the whole eco-system?

B.6 Interview Guide for Adrian Ulisse

- Can you please introduce yourself?
- Can you please tell us about the job of ETHOS and your role in ETHOS.
- Can you please describe Integrated and sustainable cities?
- How do you define Smart City?
- As a consultant you have worked with different private and public sectors. Can you please tell us about how do you deal with different sectors?
- Can you describe the idea behind the Smart City Linked Open Data Portal what are your main considerations?
- How do you establish incentives for different public/private parties to participate in the open data governance and development?
- What do you think is the main factor that should be emphasized or put maximum focus on while developing a linked open data platform?
- How do you ensure that your open data solutions are economically viable/sustainable in the long run? Do you make them scalable?
- Do you find it important that decisions are made in agreement across the whole eco-system?

B.7 Interview Guide for Lasse Steenbock Vestergaard

- Can you please introduce yourself?
- Can you please tell us a bit more Alexandra Instituttet and your role in it?
- How do you define Smart City?
- What do you think is the role of open data in Smart City or How can open data contribute to smart city ?
- How can open data contribute to sustainability?
- Can open data be a game changer in developing sustainable business?
- How do you establish incentives for different public/private parties to participate in the open data governance and development?
- What do you think it needs for the implementation of a platform for sharing data between the public and private sector? Who are the actors involved?
- How do you ensure that your open data solutions are economically viable/sustainable in the long run? Do you make them scalable?
- Do you find it important that decisions are made in agreement across the whole eco-system?

Appendix C

List of contacted people

Name	Email	Organization	Title
Kristoffer	k.p.hvidsteen@accent	Accenture	Business Strategy
Hvidsteen	ure.com	LTD	Manager
Søren Møller	smj@copcap.com	Copenhagen	Project Consul-
Jensen		Capacity	tant
Henrik Kors-	korsgaard@cs.au.dk	Aarhus Uni-	Researcher
gaard		versity	
Søren Kvist	digiteam@tmf.kk.dk	Municipality	Enterprise Archi-
		of Copenhagen	tect
Ville Meloni	ville.meloni@6aika.	Forum Virium	Programme Man-
	fi	Helsinki	ager
Adrian Ulisse	adrian.ulisse@ethosv	ETHOS	Chief Executive
	o.org	SMART	Officer
Lasse Steen-	lasse.vestergaard@al	Alexandra In-	Specialist Smart
bock Vester-	exandra.dk	stitute	Urban Designer
gaard			
Lene Lange	lla@adm.aau.dk	Aalborg Uni-	Professor in Aal-
		versity and	borg University
		CLEAN	and Board mem-
			ber in CLEAN
Torben Aaberg	TA@bdforum.org	Head of Public	Baltic Develop-
		Affairs	ment Forum
Katarzyna	kdy@bdforum.org	Baltic De-	Project Manager
Dygul		velopment	
		Forum	
Anri Kivimäki	Anri.kivimaki@oulu.f	Oulu Business	Program Manager
	i	School/Uni-	
		versity	
Peter Bjørn	pbl@cphcleantech.com	CLEAN	Business Develop-
Larsen			ment Manager -
			Smart Cities

Name	Email	Organization	Title
Michael Jo-	mjo@cphcleantech.com	CLEAN	Head of Business
hansen			Development
Michael Burns	Michael.burns.20glas	University of	Knowledge Trans-
	gow.ac.uk	Glasgow	fer Manager
Martin Bryn-	brynskov@cavi.au.dk	Aarhus Uni-	Associate Profes-
skov		versity	sor
Neelabh Singh	nes@cleancluster.dk	CLEAN	Head of Strategic
			Projects
Jarmo Eskeli-	jarmo.eskelinen@foru	Forum Virium	President, Euro-
nen	mvirium.fi	Helsinki	pean Network of
			Living Labs and
			CEO, Forum Vir-
			ium Helsinki
Sari Luostari-	sari.luostarinen@6a	6Aika strategy	Programme Man-
nen	ika.fi		ager
Lean Doody	Lean.Doody@arup.com	Arup	Smart Cities Con-
			sultant
Ditte Rønde	ditvei@um.dk	Invest in Den-	Investment
Veise		mark	Manager- ICT,
			Food & Location