



Norwegian University of
Science and Technology

Interoperability in Smart Cities

Urban IoT and designing new city services

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Industrial Design Engineering

Submission date: June 2017

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Foreword:

This Master Thesis was written in spring 2017 at NTNU Trondheim in collaboration with Powel.

I express my sincere gratitude to my supervisors Ida Nilstad Pettersen from IPD, and Tonje Evanger and Klaus Livik from Powel. Thank you for all the guiding and constructive feedback during this journey. I would like to thank Powel for their trust in me with this thesis. Furthermore, I want to thank everyone for their time for the various workshops and interviews that I conducted. Also, I want to thank all the people that filled out the questionnaire and helped creating the fundamentals of this thesis.

Trondheim, 09/06 – 17

Sammendrag:

I min masteroppgave har jeg utforsket organisasjonene, strømmingene og de store drivkreftene rundt konseptet Smart City. Gjennom flere intervjuer og workshoper har jeg identifisert mangel på brukerinvolvering i byutvikling som et gjennomgående problem. Undersøkelsene har vært basert i Trondheim.

Innsikten ble brukt i utviklingen av et konsept for en gryende rolle, en Smart City utviklingsleder, og la fundamentet for en felles plattform med formål om å senke terskelen for samskapning mellom borgerne og Smart City initiativer.

Abstract:

Within the scope of a Master Thesis I explored the communities and movements surrounding the concept of Smart City. By conducting multiple interviews and workshops I was able to highlight the lack of user-involvement in today's city planning. The research was based in Trondheim. I used this insight to create the concept for an emerging role, the Smart City Manager and created the fundament of a platform that helps bridging the gap between the citizens, and the smart city initiatives.

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Organizations involved in the research:

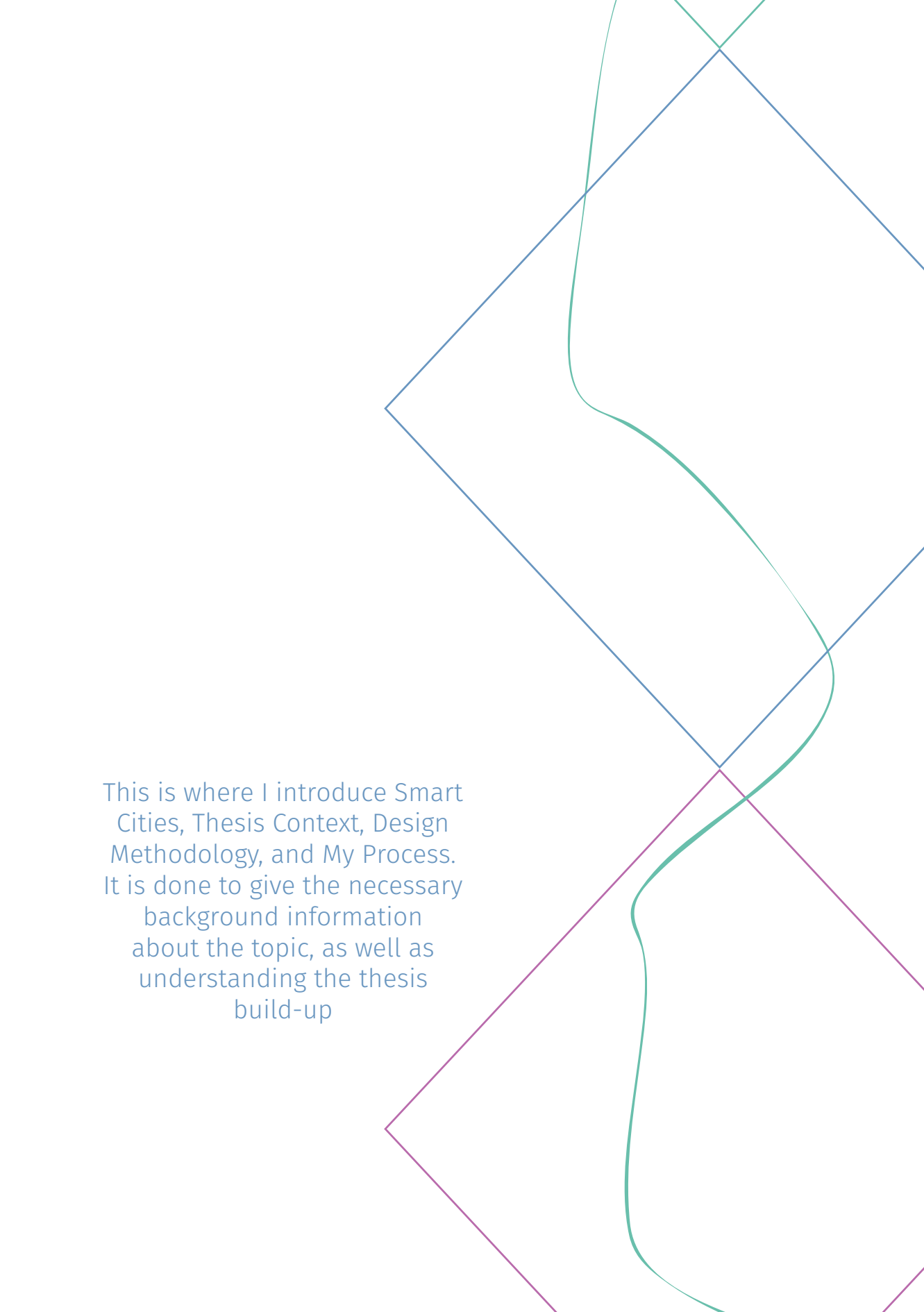
- **FME ZEN** is The Research Centre on Zero Emission Neighbourhoods in Smart Cities.
- The Faculty of Architecture and visual Arts at NTNU is the host institution together with SINTEF, and in total 32 industry and governmental partners work together with the researchers from NTNU and SINTEF to develop buildings- and urban areas solutions to help realize the zero-emission society. FME ZEN is partly funded by R&D partner, partly by The Norwegian Research Council. In total 400 million NOK is invested in the 8-year program, running from 2016 to 2024.
- FME ZEN work to develop 7 pilot projects of zero-emission neighbourhoods (ZEN's) in Oslo, Bergen, Trondheim, Bodø, Steinkjer, Elverum and Evens-tad. The ZEN's are the testing grounds to develop environmentally friendly materials, technologies and construction systems to project and operate energy-efficient areas, interaction with overall energy systems and to create new business models, roles and services for transition to energy efficient community.
- **FME ZEN, Work package 1:** Analytic framework for design and planning of ZEN.
- Work package 1 is the first of six work packages in FME ZEN. I have mainly worked with researchers from WP1, which is divided in three sub areas. They look at definitions, metrics, quantitative and qualitative data, data management and monitoring to develop benchmarking targets for ZEN, as well as life cycle analysis at a neighbourhood scale and to make a citizen-centred architectural and urban toolbox, including visualisation and decision support.
- **PI-SEC:** Planning Instruments for Smart Energy Communities
- PI-SEC is another collaboration between research institutions like NTNU, SINTEF and different governmental and industry partners. Their focus is energy design at a neighbourhood scale, suitable for Norwegian planning context in cooperation with public stakeholders.

Clarification of terms:

- **MSc** – master of science
- **Public service provider** – The business of supplying a commodity like electricity or gas or a service like transportation, schools and playgrounds to members of a community. A public service is provided by the governance within a jurisdiction, either operational and/or financial aided.
- **Horizon 2020** - The biggest EU research and Innovation programme in the world with nearly €80 billions of funding available from 2014 to 2020. With political backing of Europe's leaders and the European Parliament, Horizon 2020 is the financial instrument aimed at securing Europe's global competitiveness. The research initiative focus on smart, sustainable solutions, growth and jobs.
- **Lighthouse projects** - Are a category of Horizon 2020 research projects, aimed at smart city projects combining ICT, mobility and energy
- **OASC** - Open and Agile Smart Cities network
- **Open data** - Data that is free for everyone to use and share
- **SC** – an abbreviation for Smart City
- **ICT** – Information and Communication Technologies. It generally refers to all the components; device, network, application and systems that enable organizations and people to communicate and interact.
- **Big Data** – the overwhelming abundance of information data that is generated today. It is a broad term, without a distinct definition but generally refers to the pool of data and metadata from sensors, public records, social media and similar that can be used to understand and improve current situations.
- **Smart Data** – formatting, visualizing and extracting vital information from the pool of big data. This is desirable for optimizing procedure, support decision making and enable actionable output on how to do things better in the future. It's the process of making data sensible, for example translating it from a sequence of numbers or random dots to outlining a pattern or graph.
- **Fast Data** – Real-time data feeds, giving the ability to act upon situations directly. Traditionally most information like news, research and media is affected by a time-delay from the situation occurs until its broadcasted and spread amongst decision makers. With real-time updates the aim is to react to emergencies, attitudes and trends in an instant matter.

Chapter One

Introduction

The background features several overlapping geometric shapes. A large blue triangle is positioned in the upper right. A green shape, resembling a stylized 'S' or a curved line, is layered over the blue triangle. A purple triangle is located in the lower right, overlapping the green shape. The text is placed in the lower-left quadrant of the page.

This is where I introduce Smart
Cities, Thesis Context, Design
Methodology, and My Process.
It is done to give the necessary
background information
about the topic, as well as
understanding the thesis
build-up

Smart Cities

Where does Smart Cities comes from?

The development of the term; initially been perceived as a control system, where you keep track of city resources and efficient run of the city with focus on optimizing assets. The continuation of the technological smart city view is the IoT smart city: smart objects in the city the people can interact and get information from.

Why is smart city gaining momentum now?

The drivers behind smart city, are many and intertwined.

- Biodiversity; the need for sustainable change
- Urbanization; the geographical concentration of challenges
- Globalization Trends: digital single market, open data, automation and lack of work for skilled workers, interconnected economies and escalating political divide.
- Urban living: Circular Economy, direct democracy, peer to peer exchange and co-creation between governing powers, industry and citizens.
-

They all form an ecosystem of problems and some potential solutions. Smart city exists within this context as one praised strategy for how to change the direction in these disruptive trends and prepare for the future.

The challenge today

Smart city is becoming more and more about smart understanding of entangled problems. The complexity is overwhelming, and with so many intertwined and pressing challenges it is no longer obvious what need fixing or how to attack the hairy beast. The focus becomes how to create actionable output, by using for example big data, IoT and other technological advances to understand and facilitate good decision making.

Thesis Context

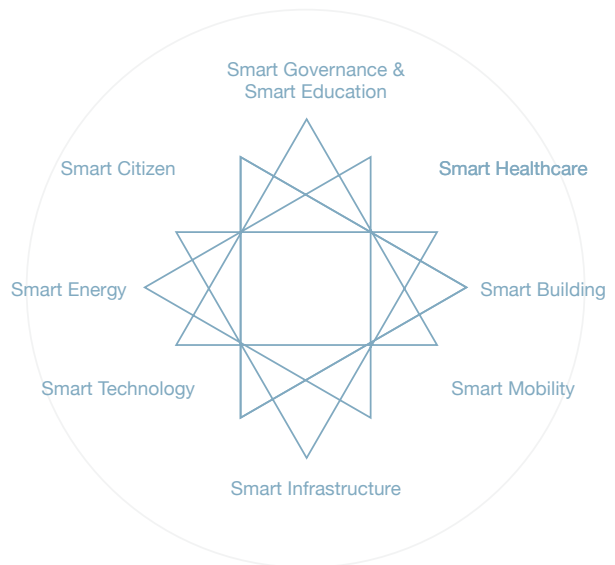
Powel in the Smart city development

To make sense of the complexity, Smart city is often divided into specific domain areas. The reason Powel was initially interested in Smart City was because they could see that they already work across many of the smart city sectors like energy and infrastructure. The project 'Powel Smart city' was started because Powel were intrigued to see if and where they could position themselves as a SC supplier.

The goal of this thesis:

The goal of this thesis was to research interoperability in urban services - and together with the project 'Powel Smart City' - identify initiatives that can help build a meaningful range of public services in sync with a smart city framework. The scope was set to Nordic cities, with extra attention on Trondheim and the Open and Agile Smart Cities (OASC) network.

Interoperability seemed like a fitting focus as the core for smart city is about working interdisciplinary, but one of



A model of how smart city is often portrayed as divided into different sectors. This is one example, but there exist many versions of Smart City categories

today's major challenges is streamlining data so it can be used across sectors. OSAC work on standardizing data, because as long as it doesn't exist a common 'language' of format, API and standards for data to be published and accessed, a lot of unknown, potential useful information is simply locked away in public records. The lack of data interoperability is a massive technological barrier for smart data usage.

The original problem description was aimed more towards 'Smart city dashboards' and how to mix data from different sectors to

forecast city and user behaviour. With the supervisory focus, the initial framing of the thesis was closer to the traditional surveillance concept of Smart City.

However, as the project has unfolded with input from desk-top research and key stakeholders the focus has shifted from smart use of operational data to smart understanding of the citizens in a city. I have therefore moved away from the OASC network as a defining factor and the final concept is aligned towards the new perspective of Smart City with focus on informed decision making.

From Management driven to Citizen driven:

The thesis goal was redirected to enable urban decision makers to better understand the citizens, because of research of how the Smart City concept is changing from management driven to citizen driven.

Many grass-root communities like the civic tech society has both the technological know-how to utilize public data and the ideological drive to change societies to more citizen centred. These organizations are becoming more influential, and their view is also supported by official institutions.

The Quadruple Helix is an innovation model explaining how government bodies, academia, business sector and citizens need to be considered equal players in the innovation system. There are global, potential disruptive trends affecting all sides of the helix and change need to be embraced, not feared. The helix is promoted

as part of the EU's digital single market strategy as well as local initiatives like Smart Innovation Norway (1,2). Because of this new multifaceted Smart City view that has emerged, my research has involved stakeholders from the municipal-, citizen-, industry- and research sphere.

Redefining the assignment:

The new definition of the assignment is creating an overview of the stakeholders, as well as target users in the Smart City environment and how Powel could enter this market with a product that serves multiple users.



Master Thesis for Kristin Rovik Gabrielsen

Interoperability in Smart Cities – Urban IoT and designing new city services

Samspillsevne i smarte byer – Urban IoT og design av nye tjenester

Circular economy and urban growth: Globalization and the digital revolution affects the way we do business today, and the ability to share information is the key factor that accelerates our changing markets. Additionally, trans-national responsibilities like climate change and need for better resource management are linked to the rapid, on-going urbanization of the world. 73 % of the European population now lives in urban settlements and as the trend continues, the challenges and solutions for sustainable development will be increasingly concentrated in cities.

Re-designing the city supervisory board: An urban Internet of Things (IoT) where operational data from infrastructure and other sources is shared and linked in new ways, can be a founding element in how to make better use of public resources and solve many of the social, economical and environmental challenges in cities. Furthermore, it would be most beneficial for local authorities to steer the development in this direction. The deployment of a shared, urban communication platform could reduce operational and administrative costs, improve user experience of public services and fuel new synergies, new services and new business models.

Master thesis: In collaboration with the European technology business Powel AS, a prominent supplier of infrastructure software solutions, this master will research interoperability in urban services. Together with the project 'Powel Smart City', the goal will be to identify initiatives that can help build a meaningful range of public services in sync with a smart city framework. The concept of 'Smart city dashboards' and mixing data from different sectors to forecast city and user behaviour will be a key element. The scope will be Nordic cities, with extra attention on Trondheim and the Open and Agile Smart Cities (OASC) network. The research will emphasize user involvement, and seek out knowledge from users and the city sector, as well as potential 'unknown unknowns'.

The task will amongst other things include:

- Insight through workshops, interviews and analysis of users and situations
- Mapping of future challenges and opportunities for the urban services
- Idea and concept development

Thesis will be carried out according to the "Guidelines for master thesis in Industrial Design".

Department supervisor: Ida Nilstad Pettersen
External supervisor: Tonje Evanger
Company contact: Klaus Livik

Starting date: 13. januar 2017
Due date: 9. juni 2017

Trondheim, NTNU, 13. January 2017


Ida Nilstad Pettersen
Departmental supervisor


Head of Department

Design Methodology

Not going to solve global problems by working by siloed approaches

In 2008 Tim Brown, CEO and president of the hugely influential design and innovation firm IDEO asked if there is a general definition of design thinking and if it is even useful to have one? In 2016, he stated that design itself needed a cultural shift to break out of siloed design practices and adopt a deeply interdisciplinary and collaborative approach to tackle today's toughest challenges like healthcare, education and government. And in 2017 he co-launch the circular design guide as a holistic, systemic way of re-designing societal structures (3,4).

Design thinking, circular design, strategic-, system- and service design are all attempts of framing different aspects of design methodology. The need to 'box' methodology clash with the core message of what Tim Brown is saying; that we should avoid subject definitions and it is not so important to worry about application, borders and specifics. It is more important to harvest the benefits of different subjects and methods, look at a problem from many angles and zoom in and out as the challenge and problem scope emerges.

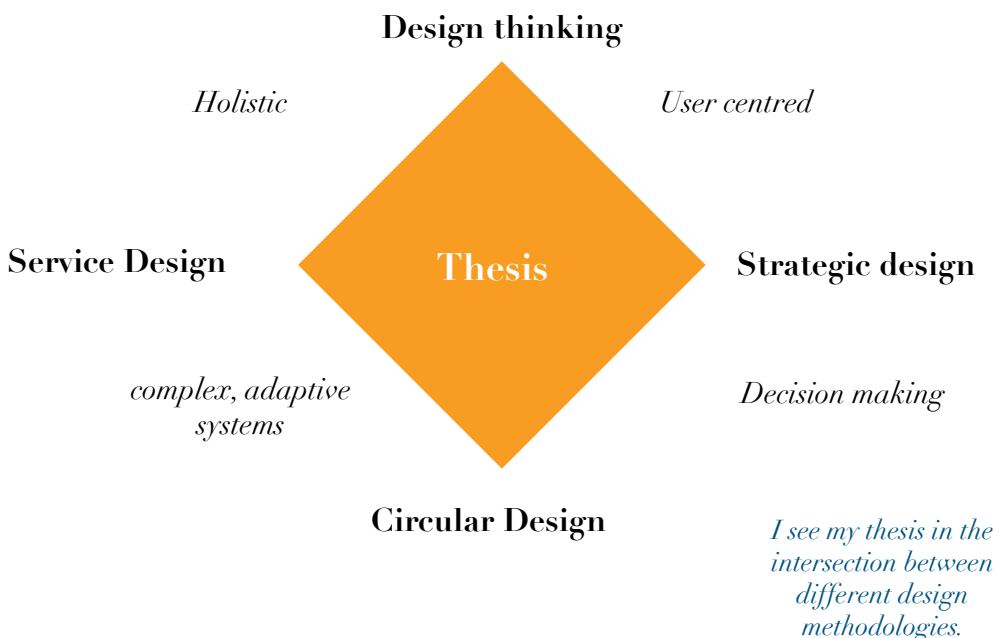
This thesis in the middle of many design practices

The reason this is relevant for my thesis is the fundamental problem of defining a precise design strategy when all the evidence points to design being interconnected and process-diverging by nature. The methodologies have expanded into new areas and the complexity of the design brief has grown. As a topic, Smart Cities is also in the very midst of this holistic and systemic way of re-designing societal structures - with all the inherent fluffiness that follows.

I have therefore not classified my work process in this exploratory thesis according to any specific design methodology, but instead see it in the intersection between different design angles. However, as an overall aim when dealing with Smart city multi-faceted nature, I have used the Helsinki Design Lab's outlook on Strategic Design as a guiding principle.

‘The scale of what we’re designing has shifted from products, to companies, to economic systems

Tim Brown



Strategic Design by definition of The Helsinki Design Lab

Design for Decision Making

The Helsinki Design Lab (HDL) states that strategic design is about crafting decision making. They explain how our world is changing faster and faster and is now turning into an era of complex, fuzzy and interdependent challenges. While society in the past have been well served with increasingly specific and deep expertise, the solution is no longer in any one silo, but in the mix. The problem of being able to do sensible decision making therefore arises because our current systems have left us trained and skilled in engineering solutions, but often unable to see the real and sophisticated nature of the problem we are trying to solve (5).

HDL Design guidelines for better decision making (5)

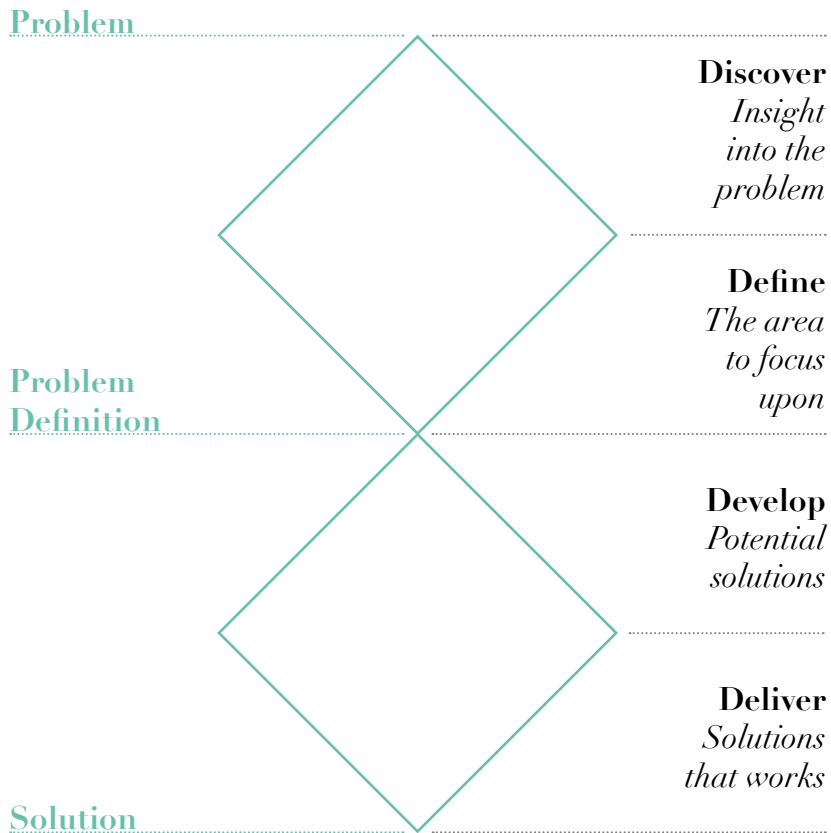
The aim of strategic design however is to craft better decision making by

- **Integrating:** enable decision makers to see the big picture, with stakeholders and societal echoes of their decisions. It is well described as seeing the different layers and complete architecture of the problem.

- **Visualization:** Spreadsheets and other familiar analytic tools become insufficient, when the challenges are so complex and uncertain. To grasp the entangled relations and often contradicting plot of the problem, the strategic designer uses visualisations to portray and communicate the situation to others.
- **Stewardship:** Finding a solution to a problem is easier than ensuring it is implemented in the intended manner. To deliver durable solutions and keep the integrity of an idea, strategic designers should be involved in the change process.

My process

If there is one thing the different direction within design practices tend to agree on, it is that design is a non-linear process that is constantly diverging and converging. As new insight and restrictions are discovered, they shape both the concept and the continuing process in the most suitable direction. Following is a visualization of my process with insights, methods and redefining of problem framing. The visualizations are based on the design process as outlined by the British Design Council (6).



The original

The British Design Council double diamond consist of four distinct phases; discover, define, develop and deliver.

The first diamond has both a diverging and converging phase where the focus is to identify the real problems at hand. In the diverging phase the broad topic is researched and explored, and in the converging phase insights are synthesised and refined to verify the right problem definition.

The next diamond illustrates a new diverge- converge process where potential solutions are first explored

and later refined into context relevant deliverables (6).

Although this model provides a basic outline of the design process, the actual workflow is still an iterative development where a proper problem definition and concept development can work both fluently across and/ or aligned to each other.

**Starting Point:
Thesis description**

**Problem
Definition**

**Context
Definition**

**User
Definition**

Solution

My Process: 3 phases

My own process has been highly iterative, with three diverge-converge phases to define relevant definitions for Smart Cities. The definition for problem, context and user is the frames for the final design brief. The concept has also been iterative developed throughout the whole process, moulding and changing focus as new definitions for smart city came into place.

Redefine problem & narrowing scope

How to give urban decision makers a more realistic view of citizens actual priorities?

Discovering a new Smart City view

Civic Tech Society and how Smart City outlook is changing from management driven to citizen driven

The Smart City Manager

A new role emerging

Result: Service Concept

Starting Point: Thesis description

Events :

- *Workshop Trondheim Municipality: Smart City Dashboard*
- *Interview ICT Adviser at The chief administrative officer staff, Trondheim Municipality*
- *Meeting FME ZEN & NTNU Campus development project*
- *User journey/ Mapping stakeholder timeline with FME ZEN & PI-SEC*
- *Workshop: Neighbourhood from citizen perspective*
- *Interview Sales Manager Water, Powel AS*

Problem Definition

- *Art & Technology course: discovering Civic Tech Society*
- *Discovering Smart City as Complex Adaptive Systems (CAS)*
- *Discovering David Snowden and his triangular self-assesed answering methods to access emerging trends of personal sentiments.*

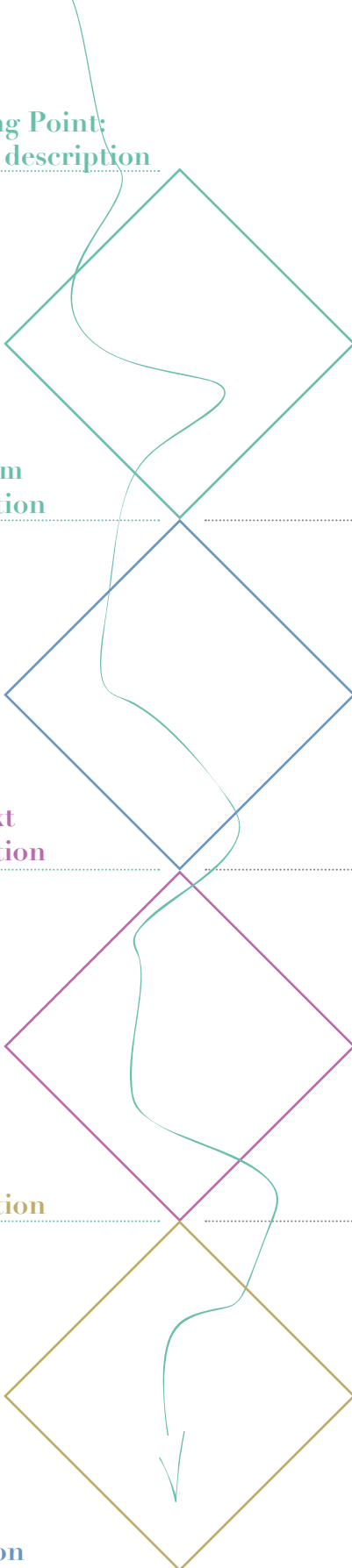
Context Definition

- *Discovering The Smart City Manager*
- *Workshop 'Big design: initiatives in politics and society', hosted by Big Design/ Trondheim municipality*
- *Workshop: hosted by Powel Smart City group*

User Definition

- *Development*

Solution



Methods:

- *Desktop research*
- *Workshop facilitating*
- *Semi-structured interview*
- *User journey/ mapping stakeholder timeline*
- *Giga- Mapping*

-
- *Desktop research*
 - *Visualizations & Explanations*
Models based on Giga-map

-
- *Workshops & Business model Canvas*

-
- *Questionnaire*
 - *Concept visualizations*

Events & Methods used during the thesis

Giga- mapping

Giga mapping

Throughout the process I have used giga-mapping as a method for synthesising often fluffy and complex insight into strategic maps and visualization. Finding from all the activities; workshops, interviews, stakeholder timeline and literature have been integrated into the giga-map and crystallized my understanding of the whole societal mould Smart City is being shaped in today.

In the giga-map I use color-coding to classify the insights. It is purple for political drivers, blue for business model drivers and yellow for technical drivers. For overall smart city concept, I've used green.

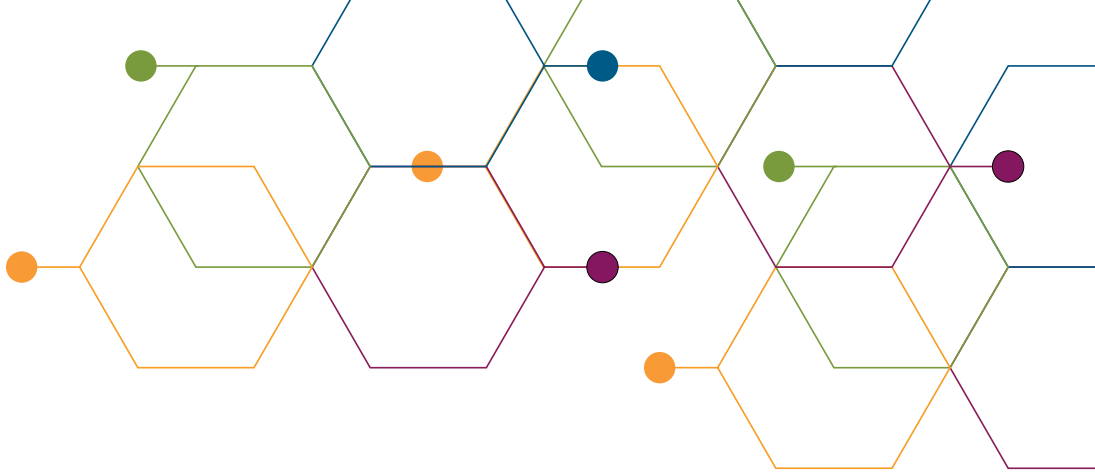


I see the giga-map as my 'floor tiling', where I have laid out all the bits and pieces and together the individual bricks have formed a pattern from which I could draw some main conclusions. These key insights would have been difficult to spot alone – set apart like they are in individual blocks of information domains - but with the information sewed together in a connected pattern I was able to distil knowledge and form my founding hypotheses.

From the floor tiles, which illustrate the current trend and conditions for Smart City, I have extracted a foundation of problem, context and user definition for what I mean will be important in the future. On top of that foundation I have built a framework for my SC concept.

Vacuum and goldsmith

The giga map is a knowledge container where I first put down all the findings from a 'vacuuming phase'. The vacuuming phase is about sucking up existing information to identify current patterns. In a second 'goldsmith phase' I started refining context on top of that, but still using research methods to figure out



'un-existing information' or unknown unknowns. Another way of seeing it is that the vacuum phase collects certain information, and the goldsmith test uncertain information.

Thesis build up

In the vacuum phase I added information to the giga map, and in the goldsmith phase I extracted information for further research and concept development. The thesis disposition is therefore divided into the vacuuming and goldsmith phase, with the giga-map going like a connecting thread through them.

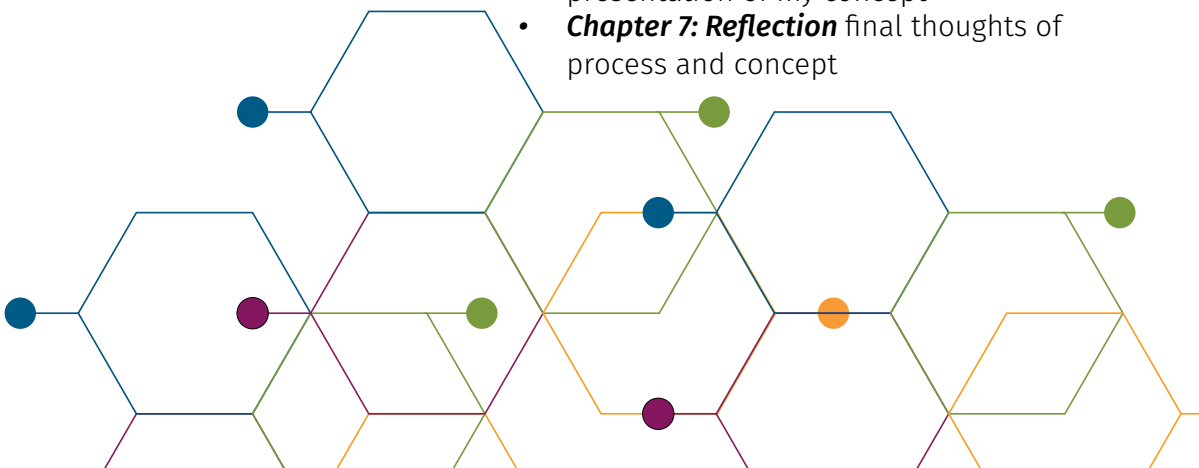
Chapter two, three and four belongs to the vacuuming phase, and five, six and seven to the goldsmith.

Vacuumin:

- **Chapter 2: Methods and findings.** In chapter two I present the activities, methods and the main findings from them.
- **Chapter 3: Problem-, context- and user definition.** In chapter three I present the problem, context and user definitions together with their background
- **Chapter 4: Emerging key insight.** This is where I combine the definitions and sum up what I aim to achieve with my concept

Goldsmith:

- **Chapter 5: Ideation and concept testing** Linking users and decisions makers - questionnaire
- **Chapter 6: Final concept.** A presentation of my concept
- **Chapter 7: Reflection** final thoughts of process and concept



Chapter Two

*Activities &
Findings*

This section is divided into 4

- 1; explaining process of Giga-Mapping,
- 2; research used for the problem statement,
- 3; research used for the context definition,
- 4; research used for the user definition

- **Giga-mapping:** parallel to all research activities and combined with desktop research

The first research on smart city: Defining the problem

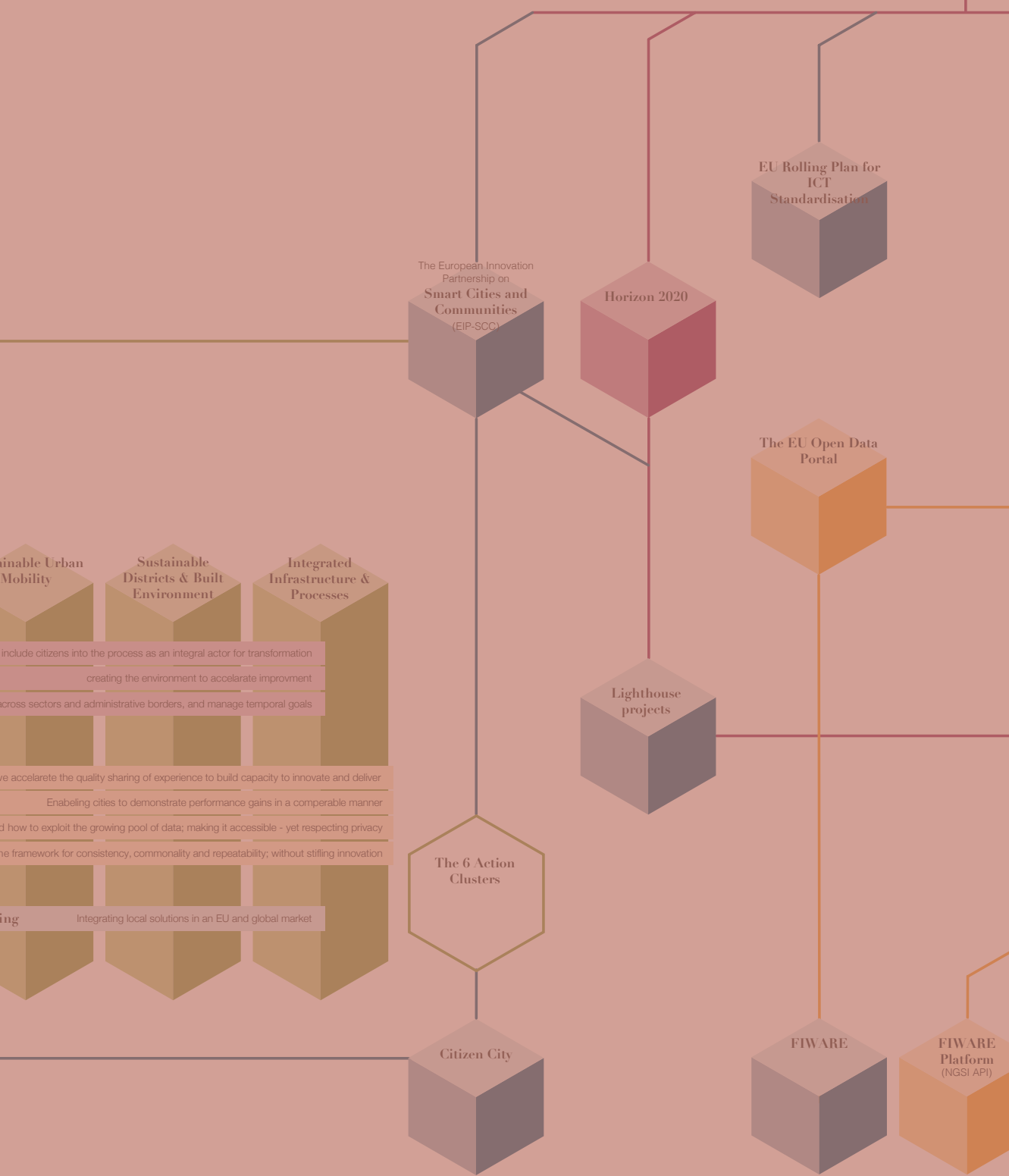
- 18/01 - 17: Workshop Trondheim Municipality: Smart city Dashboard
- 25/01 - 17: Interview ICT adviser at the chief administrative officer's staff in Trondheim.
- 27/01 - 17: Meeting NTNU Campus Development Project & FME ZEN
- 02/02 - 17: Workshop FME ZEN and PI-SEC (mapping decision maker journey)
- 08/02 - 17: Workshop continuation of decision mapping with FME ZEN
- 08/02 - 17: Workshop 'Neighbourhood from user perspective' with architect MSc course
- 20/02 - 17: Interview Powel Sales Manager

The second research on smart city: Defining the context

- 20- 24/03 - 17: Art & technology course - extensive mapping of the on-going Civic tech initiatives
- Desktop research: Complex adaptive systems
- Desktop research: Davis Snowden - triangular answering method/ 'making sense of complexity in order to act'

The third research on smart city: Defining the user

- 07/04 - 17: Workshop 'Big design: initiatives in politics and society', hosted by Big Design/ Trondheim municipality
- 20/04 - 17: Workshop 'Defining the smart city manager role', Powel Smart City group



Desktop Research & Giga- mapping

The Digital Single
Market Strategy
(DMS)

Address barriers in
the European Data
Economy

Smart Cities
NTNU

ZEN The research
Centre on Zero Emission
Buildings (RCN)

02/02
Workshop with
ZEN & PI-SEC

Zero Emission
Neighbourhoods
in Smart Cities,
Leader Arild Gustavsen

EU Horizon 2020
Grant case
application
in total 30 participants
the application

PI-SEC Planning
Instruments for Smart city
Committee
PostDoc Britta Østvad
Nielsen & PhD student
Jonas Szalay

25/01
Meeting with
Arlene O'Hagan

17/01
Workshop
Bundgaard
Municipality

08/02
Workshop ZEN &
architecture students in
the MSC course emission as
design drivers

MSC architecture
Emission as d
drivers, Teach
Aoife Houlihan W

27/01
Meeting ZEN &
Campus Development

Mapping connections and trends in
the European Smart City environment
from a politically, business-model
and technically angle

OASC

CKAN

City SDK

Giga-mapping

Giga-mapping (or GIGA-mapping as it is originally written by its inventor) is a method developed by Birger Sevaldson and colleagues around the System-Oriented-Design (SOD) field from the Oslo School of Architecture and Design. SOD deals with super-complexity and wicked problems, by linking methodologies like design thinking and system thinking with visualisation in processes and communication. Giga-mapping is a form for visual thinking, where you create a 'information cloud' and use it to deduct the solution space (7).

One thing that separate giga-maps from conventional mapping is the rich and often contradicting knowledge distribution. Instead of mapping to simplify and make a system directly, giga-mapping encourages to spread the research tentacles to grasp the context complexity and later use that to define the system boundaries. The method is a way of 'thinking while drawing', so the iterative models and connections you develop form your understanding of the problem – and you do not only illustrate to document thoughts (7).

My giga mapping

In my own process, I used the giga-map for learning, research, imagination, registration and description of a complex ecology with different societal agents who is shaping the current Smart City view. By adding insight from the activities and supplementing with literature investigations, I could get an overview and identify the problem, context and user boundaries in my smart city understanding.

Although I refer to the giga-map as one it was actually several maps. From the main pattern I did many 'daughter' maps where I tinkered and model more abstract systems. The full giga-map can be found in appendix A.

Most insights listed next to research activity

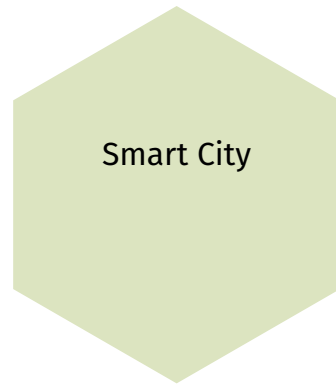
I used the giga-map as a knowledge container to link insights and organizational connections. Findings in the giga-map stems from all the activities, and elements from the giga-map will therefore be presented along with different research activities in this chapter.

Giga map key insights

Since the details of the findings will be presented along with the research activities, there is only two things I wish to highlight from the giga-map process alone.

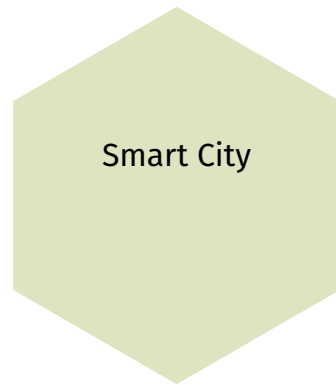
- The first thing is the extensive will and need for systemic sustainable solutions that Smart City is a part of. This commitment to develop societal, systemic changes is most prominent in EU political incentives, and is showed by the amount of money being spent on research and developing. Remnants of the European commitment can also be seen in Norwegian politics and municipal focus.
- The second thing is how today's Smart City view differ from that of the past. While the original Smart City was often 'characterized by top-down strategies for creating more efficient infrastructure'(8) as stated by Sarah Williams, director of MIT's Civic Data Design Lab, today's Smart Cities is more about solving complex

economic- and institutional systems with the help of civic minded tech-societies and citizen co-creating. Open data, the quadruple helix and new business models is also at the centre of the new Smart City.



Political will & funding

A main impression from the giga mapping is the sheer political will and funding for smart city initiatives. Smart City is not alone, but one of many elements in how to adapt to disruptive trends and re-organizing for a more sustainable future.



Key insights form giga - mapping

Today's smart city vs yesterdays

'Today's technology cities are unlike those of the past which were often characterized by top-down strategies for creating more efficient city infrastructure.

While this kind of Smart city still exist, the bottom-up Technology City shows how cities can empower citizens to become more efficient, adaptable and responsive communities' (8)



Chapter 7:
Approach & Methodology

Smart City

Dashboards

A workshop with 17 participants from Trondheim municipality and associates to identify meaningful services for both internal service providers and public users.

**What:**

Workshop with Trondheim Municipality: Smart City Dashboards

When:

18/1 – 17

Who:

17 participants from the municipality and other urban decision makers; public transport operator AtB, The Urban Planning Office, Trondheim Parking, The Research Centre on Zero Emission Neighbourhood in Smart cities (FME ZEN), Microsoft Norway, the ICT adviser from the chief administrative officer staff, NTNU Department of Computer Science (IDI), and Trondheim municipality environmental unit. The workshop was initiated by the municipal environmental unit, after a large EU Horizon 2020 lighthouse application

with 38 participants from Trondheim. Powel was hosting the event by invitation, and I planned and facilitated the ideation part of the workshop.

Why:

Identify relevant services and information sources for Trondheim City dashboard(s). The workshop focused on identifying useful services from both internal users (municipalities departments and service providers in Trondheim) and public users (citizens, tourists, urban dwellers).

Method:

Workshop preparation & facilitating; Seven time-limited group tasks, post-it ideation, key word clustering and concept mapping canvases for presentation. The participants were divided into four groups.

Outcomes: Service concepts for both internal and public users in Trondheim. Three areas stood out among all four groups: transport, innovation and healthcare.

34 Ansatte hos traPkkoperator

Oversikt Hjemmehjelp

TraPkk dashboard

Kilder

Helse dashboard

Informasjon om hvor folk onsker aa reise (f.eks skistua)

Hjemmehjelp totale sykepleiere

Faa oversikt over arrangementer; hvor skal kunder reise det neste dognet?

ticket.no

veervarsel yr.no

oversikt pasienter

Estimat paa antall reisende?

AtB digital informasjon
sensorer i bussene
Historikk
Bomringen
TraPkk telling

Ansatte/ hjemmetjeneste i bybildet naa

Hvor er bussene til enhver tid?

Fyllingsgrad i bussene

Behov for ekstra avganger? Passasjer-tilstromning

Punktlighet

Passasjerstatistikk

Tilstandskontroll av tekniske systemer i buss

Oversikt over antall barnevogner i bussene

Batteriforbruk paa bussene - optimal energilagring

Energioppfolging

ko, traPkkulykker, veiarbeid - gi kunde informasjon



Vegvesen - varslet veiarbeid

Opplyst

Kilder

aglig

EPS

aglig

Helsesensor

aglig

aglig



Results from workshop

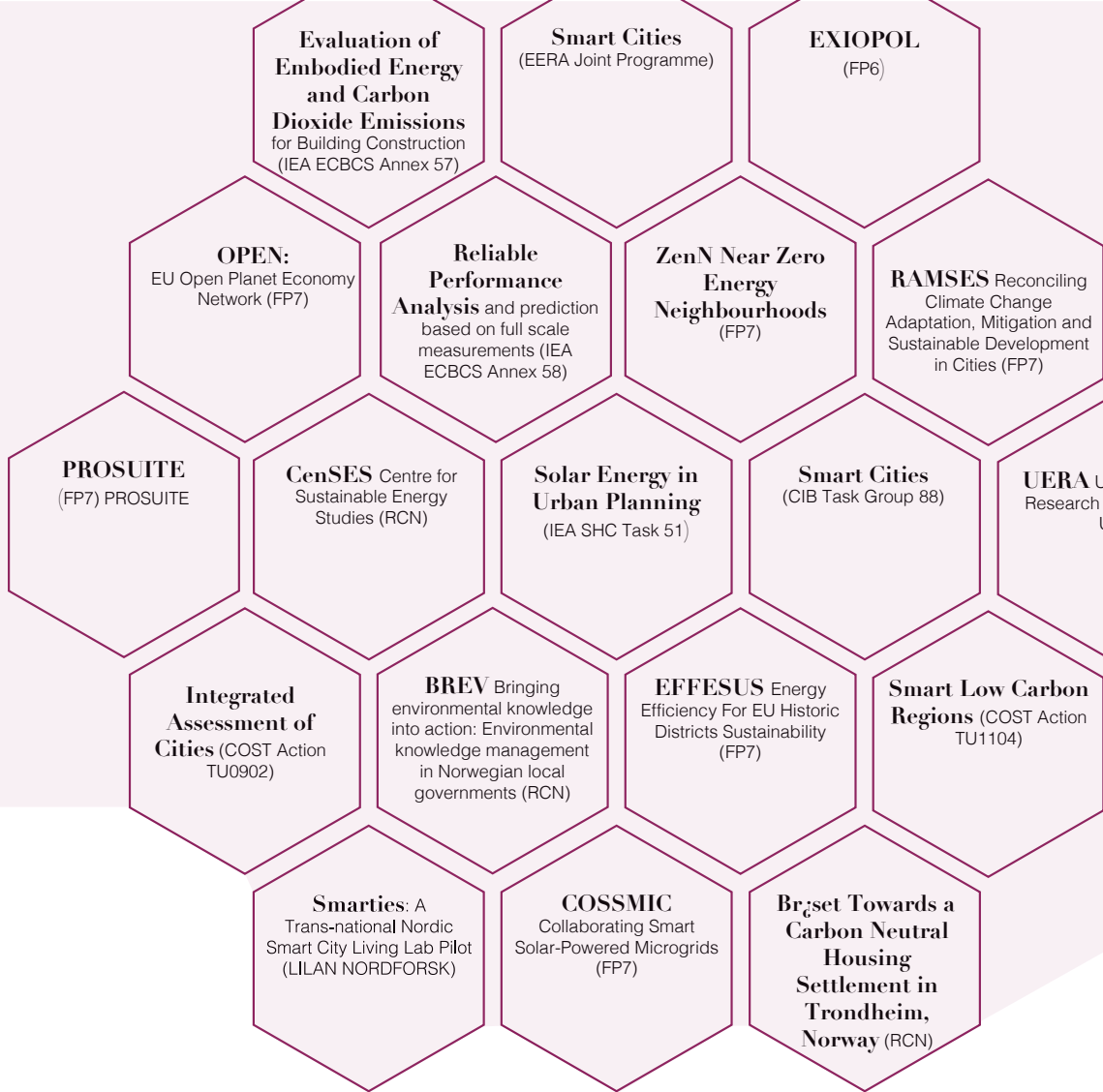
The workshop did not gather all the organizations initially invited to participate. Some actors like the tourist information and different municipality sectors did not show, and we therefore had a predominance of mobility organizations like Trondheim Parking and the local transport company, AtB.

Many of the concepts for internal service providers were therefore developed around mobility. They could identify a lot of problems with the existing systems and question that really should be answered, but currently were not. Ideas for how to improve the bus fleet, or operational flexibility depending on weather, rush traffic and customer satisfaction came up often. The other two areas that got some traction was healthcare and quantifying proof for innovation.

For healthcare, it was personnel resource managing and logging of patient status, for innovation a dashboard useful for political ambassadors of Trondheim. After the workshop the findings were synthesised in a full summary, but the further development of a Trondheim Smart city dashboard was put on hold while the municipality, Powel and Microsoft discussed a cooperation.

Overall my main impression from the workshop was the many workflow problems in various sectors. The other was that the participants realized that they could greatly benefit from sharing data and learning from others in the municipality, but data interoperability and administrative borders hindered this.





Timeline

The workshop with Trondheim municipality on Smart City Dashboard came in the wake of a collaboration on a horizon 2020 Lighthouse application. Powel was one of 38 participants on the application, where Smart City NTNU and Trondheim municipality were two main actors.

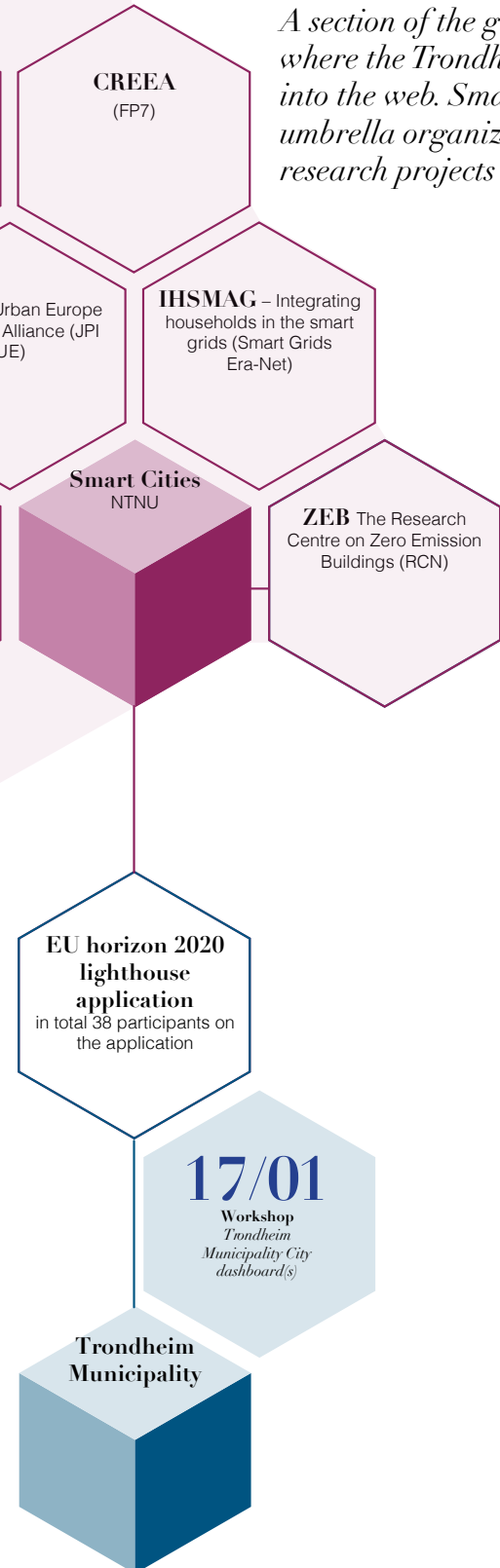
If a lighthouse application is approved it will receive funding for a smart city project

on sustainable development of urban areas with focus on energy, transport and ICT (9). With the contact established through the application, Powel, Microsoft and the environmental unit initiated the Trondheim Smart city dashboards workshop.



Smart City Politically Business Model Technical

A section of the giga-map to show where the Trondheim workshop fit into the web. Smart City NTNU is an umbrella organization for a variety of research projects on Smart City.



Smart cities NTNU

Smart Cities NTNU is a group formed to pursue ‘high value integrated design and technologies for the smart city that is the energy-efficient, resilient and healthy city’ (10). The projects shown in the illustration are all connected under the Smart city NTNU umbrella and funded by a variety of different research programs from the EU and the Norwegian Research Council. The groups work within material detailing, urban morphology, energy and mobility systems, governance, citizens, smart tools and data. Connected to so many EU and international projects and focusing on corporation with municipal and industry partners, they expect their research work to be valuable as assessment tools, certifications, budgets and policy strategies (10).

The European Union
Executive Branch

Council of ministers
The Treaties of the European Union -The constitutional basis of the EU

European Parliament
Approves and allocates the budget of the European Commission

European Commission
Proposes and implements the approvals of the European Parliament

The European Innovation Partnership on **Smart Cities and Communities** (EIP-SCC)

Combines ICT, energy management and port management for innovative solutions to the major environmental, societal and health challenges facing European cities today.

The High Level Group (supported by its Sherpa Group) and the Smart Cities Stakeholder Platform, are responsible for the Strategic Implementation Plan (SIP)

Horizon 2020

Horizon 2020 is the biggest EU Research and Innovation programme ever with nearly €80 billion of funding available over 7 years (2014 to 2020) – in addition to the private investment

They also look at how the European Commission can support these measures during the next Research Framework Programme – **Horizon 2020**

EU Rolling Plan for ICT Standardisation

The E...
Mar...

Smart Cities NTNU

Lighthouse projects

EU horizon 2020 lighthouse application
in total 38 participants on the application

Smart Cities and Communities solutions integrating energy, transport, ICT sectors through **lighthouse projects**

smart **homes** and buildings, smart **grids** (electricity, district heating, telecom, water, etc.), energy storage, electric vehicles and smart charging **infrastructures**

17/01
Workshop
Trondheim Municipality City dashboard(s)

Trondheim Municipality

ICT platforms must be based on **open specifications**

The goal is to facilitate a successful transformation towards intelligent, **user-driven and demand oriented** city infrastructures and services.

Smart City Politically Business Model Technical



Giga-mapping spreading from the Lighthouse Smart city application showed strong political will and funding to enable a data driven economy. The Eu's is investing heavily in modern technologies to adapt the social structures in a time with less resources, disruptive technology trends, marginalization and failing confidence in democratic institutions

Digital Single
Market Strategy
(DMS)

How Smart Cities are changing and implemented in a bigger picture

In the Horizon 2020 work programme for 2016-2017 they invest almost €16 billion for research and innovation in six cross-cutting initiatives. The topics are all future-oriented, ranging from automatic driving, modernizing manufacturing, Internet of Things, industrial digitalisation, Smart and sustainable Cities and 'Industry 2020 in the Circular Economy' (11).

For the Smart and Sustainable cities €232 million is offered to better integrate environmental, transport, energy and digital networks in EU's urban environments (11). This is the smallest budgets of the six, but what is worth noticing is that all six are ultimately aiming for the

same; transforming how societies are run today

The reason for doing so, stems from a multiple of reasons, and is maybe best understood when considering which EU policy priorities, the work programme aligned itself to.

Policies like the 'Jobs, Growth and Investment Package', 'Digital Single Market' and 'Energy Union and Climate change policy' (11) are all overlapping topics trying to adapt the social structures in a time with less resources, disruptive technology trends, marginalization and failing confidence in democratic institutions (12-14).

The reasons for staying adaptable, the why's in the chase for new societal structures is also changing the driving forces behind Smart City.

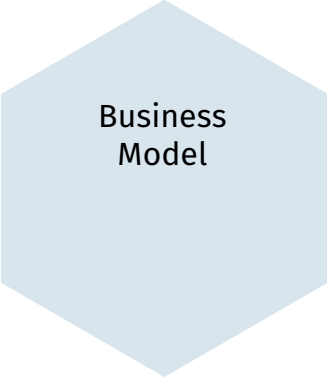
Instead of being understood as mere technological test grounds for optimizing city assets and efficiency, Smart city is becoming solutions to topics like economy and governance.

Mending the social fabric

The changes are profound and pulling at many different threads of the social fabric, so adapting to a new future needs to be iterative, interdisciplinary and 'smarter'. Proof that the Smart City context is really expanding, is the aim of the Smart and Sustainable Cities;

bringing together cities, industry and citizens to demonstrate solutions and business models that can be scaled up and replicated, and that lead to measurable benefits in energy and resource efficiency; new markets and new jobs (15).

Citizens, new markets, new jobs, industry, scale-able and new business models seem to be given more importance than resource management. Infrastructure and energy usage is still a part of smart city, but now more as how's to change, not the why's.



Business Model

A definite want for smarter solutions in the municipality

The participants where amongst other things asked to list three things that would make their workday easier if they knew it from the morning of. As the participants clustered their questions into topics a great range of needed data driven application took shape.



Smart City

Smart City term is broadening

From the desktop research and linkages in the giga-map a larger, multifaceted Smart City started to emerge.

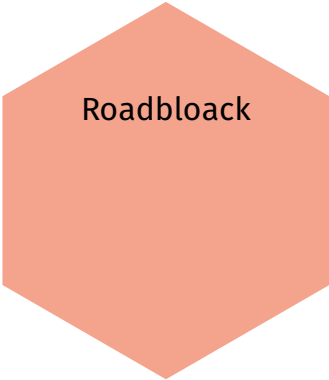
Part of a holistic plan, it was addressing how to restructure fundamental systems in our societies



Roadblock

Lack of data overview

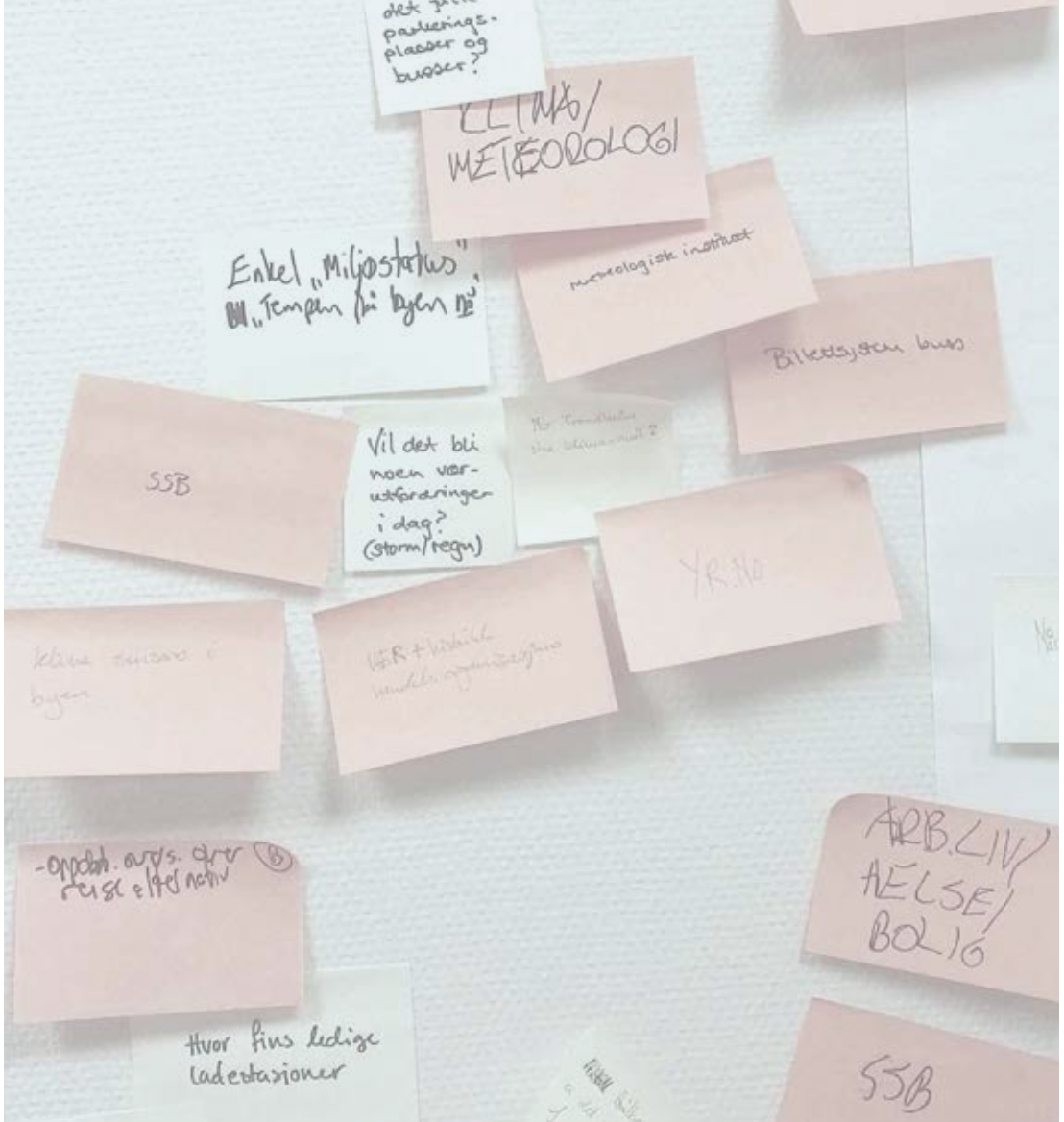
When we tried to list data sources, the participants knew mostly of the other government agencies they worked closest to. A common data library would help both municipal bodies and software developers working with the municipality to deduct what kind of information could be extracted from the data types.



Roadblock

Lack of data interoperability

Administrative borders and different format on the data created further problems. Language, API's, format storage, classifications and other standards for interoperability slowed the iterative process of developing new services considerably



A sum-up of the key insights from the workshop and research

SC pains & gains, but plenty of data obstacles

A broadening of what Smart City was supposed to fix, combined with lots of funding and political will to make big data, sensors and IoT useful in shaping a new tomorrow, was mostly hindered by data comparability. This view was affirmed both in the workshop and from the research.

Smart City as moral entities

An interview with a ICT adviser at the
chief administrative officer's staff in
Trondheim.

What:

Semi-structured Interview

When:

25/1 – 17

Who:

ICT Adviser at the chief administrative officer staff (Rådmannens fagstab) of Trondheim Municipality

Why:

To learn more about the municipalities ICT prioritising, smart city mentality, technical standards and requirements for buying software solutions, as well as their membership in OASC (Open and Agile Smart Cities). What is Trondheim municipality obliged to per OASC membership and from governmental guidelines regarding smart data use?

Method:

Unlike a structured interview with rigorous question this interview-form is open without an established form, but it is recommended to prepare a rough topic template beforehand with bullet-points and relevant questions. In the beginning of the meeting one should clarify the intentions and general topics, but otherwise keep the conversation open and leave it to the interviewee to define

which aspects he focusses on. The aim is to extract the knowledge and experience the interviewee has about your topic (16).

Outcomes:

A visual map of the most important insight classified after political, business model, technical and overall smart city ideology. The insights vary from Smart City definitions, public expectations, EU digital single market strategy, data requirements and smart Cities as moral entities.

“It’s consumer driven innovation that will change the other (governing) system”

on Economy, Creating New Industry; Providing Actionable Output.

44 **Smart City = just a New Wrapping?**

The Smart City concept in Trondheim Municipality (and the Norwegian public sector in general) is still developing. If it's used, it's mainly used as a new term for established city development areas such as transport, health, environment ect.

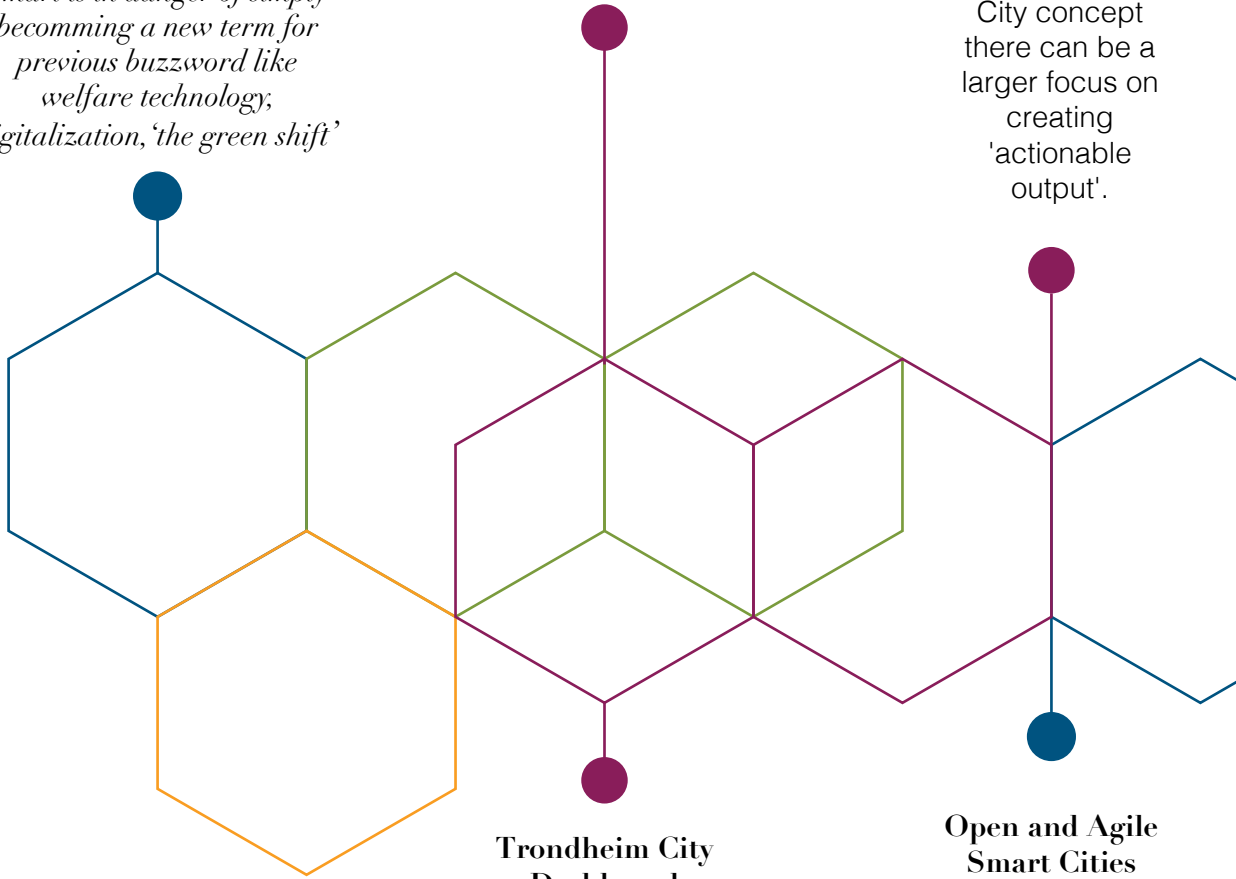
Smart is in danger of simply becoming a new term for previous buzzword like welfare technology, digitalization, 'the green shift'

Public Expectation

The public expectations from municipal services is greater - this fuel the realization that municipalities must focus on user value yield in their software services

Smart City only valuable if it provides 'actionable output'

The potential value of 'Smart City' lies in the breadth and complexity. With the Smart City concept there can be a larger focus on creating 'actionable output'.



Trondheim City Dashboard

Actionable data for a city dashboard would be if it provide **A)** citizens with behavioral changing output, or **B)** Municipality & service employees with a greater understanding of expected service providing and their role in the city.

Open and Agile Smart Cities

OASC count over a 100 cities worldwide. Stavanger, Bodø and Trondheim are Norwegian members.

A map of insights from the interview

EU Digital Single Market

The European Union is working hard to create new workplaces.

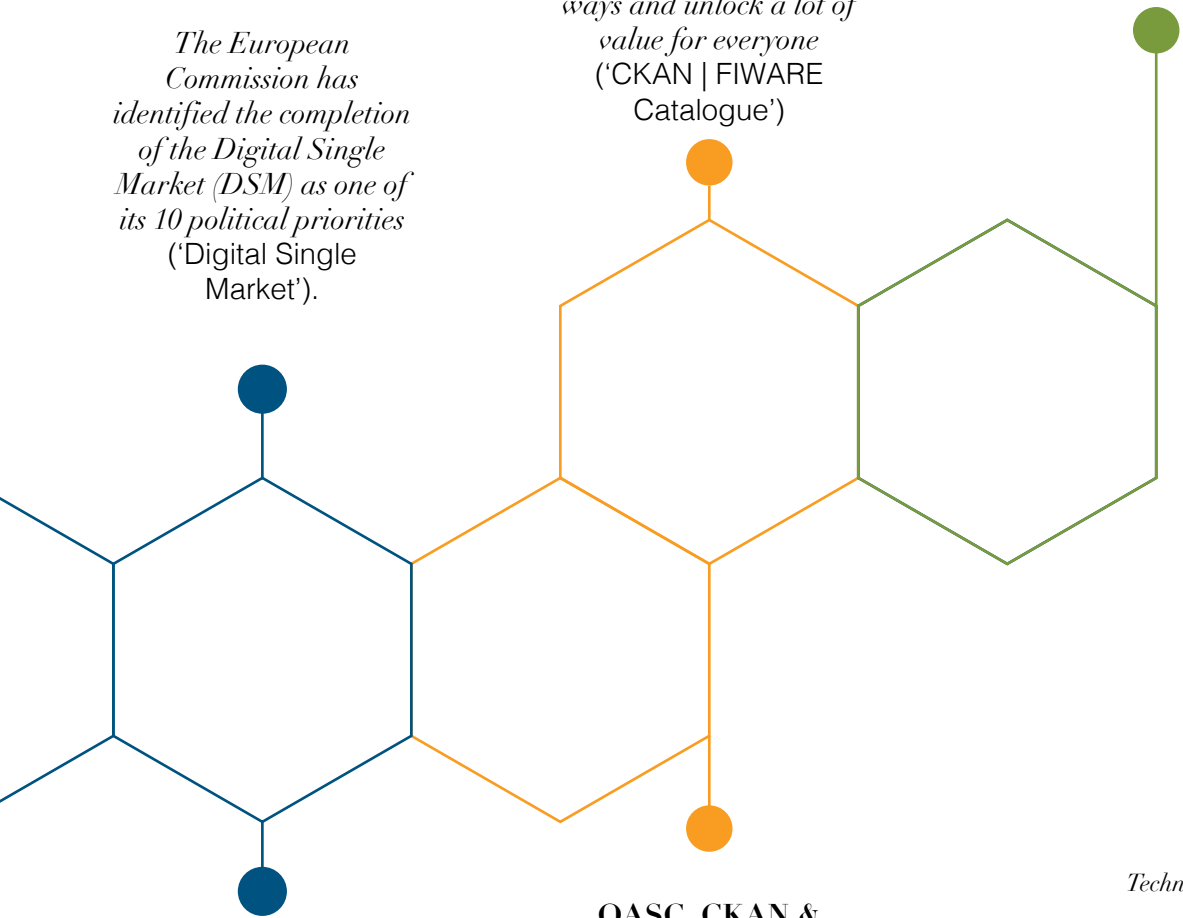
The European Commission has identified the completion of the Digital Single Market (DSM) as one of its 10 political priorities ('Digital Single Market').

Smart City Market

Data creates value. Governments do not have to provide all services around data themselves. They can empower citizens, organisations, and companies to make use of the data in new ways and unlock a lot of value for everyone ('CKAN | FIWARE Catalogue')

Smart Cities as moral entities

Create new job opportunities, enable citizen co-creation & right of codetermination



Open data and standardized architecture

OASC's overall objective is to create a united, smart City Market. Their focus is 'driven by implementation', 'open data platform', 'common API' and 'Data Models'.

OASC, CKAN & FIWARE

CKAN is a open-source data portal platform. CKAN is free and integrated in the FIWARE reference architecture, FIWARE is a data platform and a founding member of OASC.

Technical



Business Model

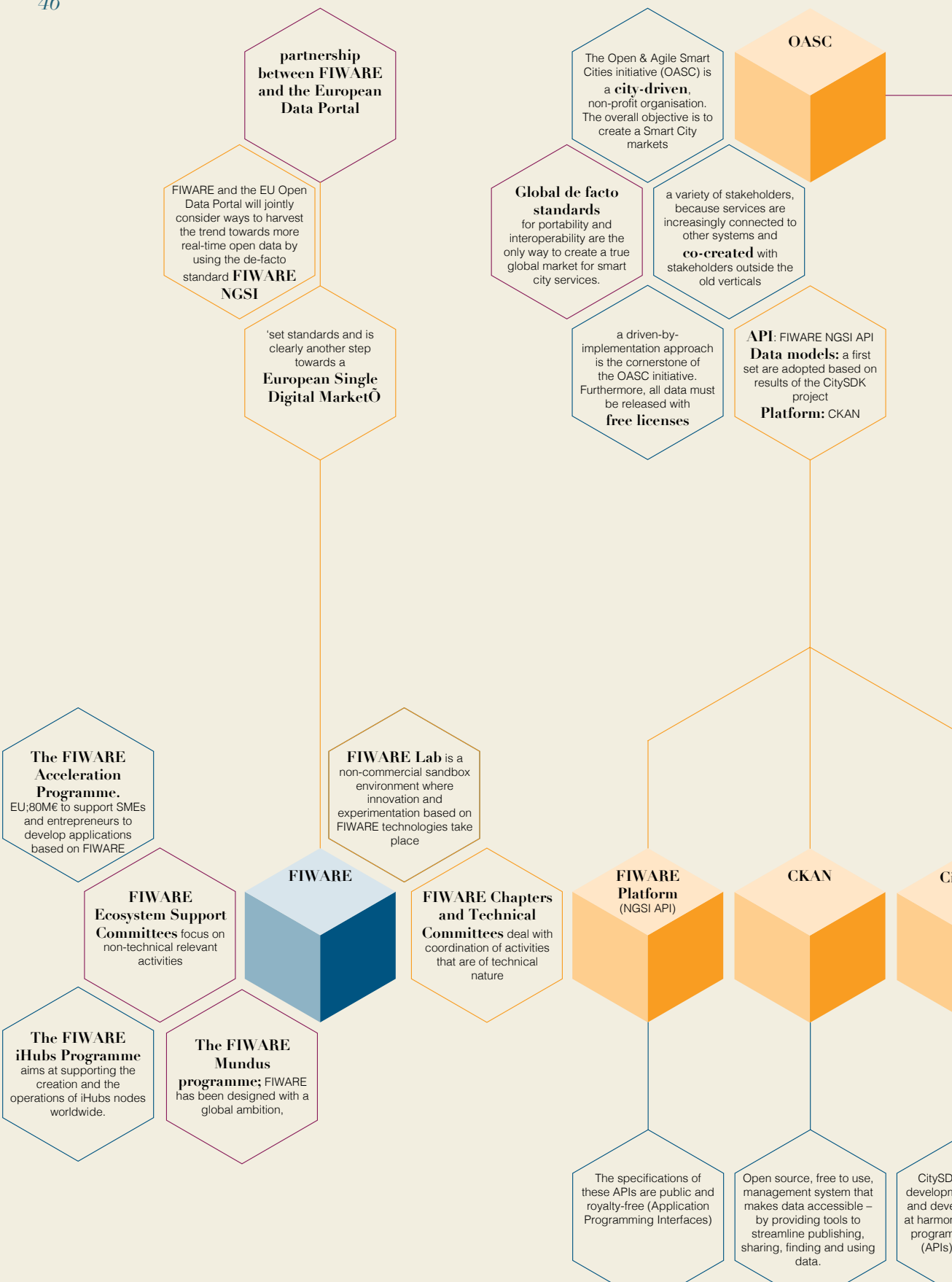


Politically



Smart City





25/01

Meeting with
Ola Eirik
KlingenThe chief
administrative
officer staff follow up
and facilitate
implementation of policy
objectives and decisions

OASC, FIWARE and CKAN are organizations working on data interoperability standards. OSAC has the goal to achieve a common, Smart City market and FIWARE is directly linked to the EU Digital Single Market Strategy.

Timeline:

The interview was arranged when we meet at the Trondheim Smart city dashboard workshop. The interview was conducted shortly after, 25.01.

My original thesis description defined that 'The scope will be Nordic cities, with extra attention on Trondheim and the Open and Agile Smart Cities (OASC) network'.

I therefore knew OASC from before, but the giga-map illustration on the left side shows how I discovered OASC and their connections during the interview and in the following research.

OASC

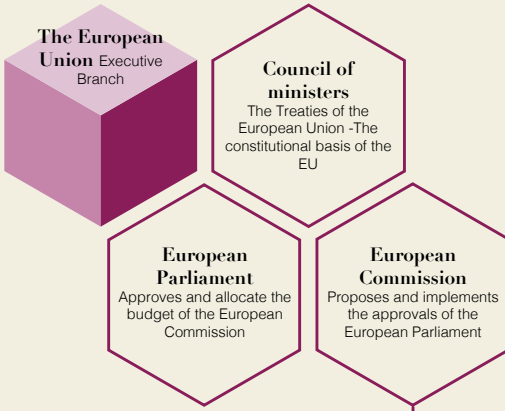
Trondheim is one of over 100 members of OASC, an organization working on creating a united smart city market, for cities by cities. A single city is not a market for a developer, so to achieve scalable new SC software to be made OASC work on standardizing API's, data models and platforms (17,18). Open collaboration is key, and OASC is connected to FIWARE.

FIWARE

is an open source organization, providing help and a data framework/software standards for developing new solutions in the data economy. It is an open source and free to use operating system, but requires that data application built on FIWARE standards are public and royalty-free (19)- in short; applications built so that others can access and re-use the code. FIWARE are partners to EU' open data portal and connected to the EU' single digital market (DSM).

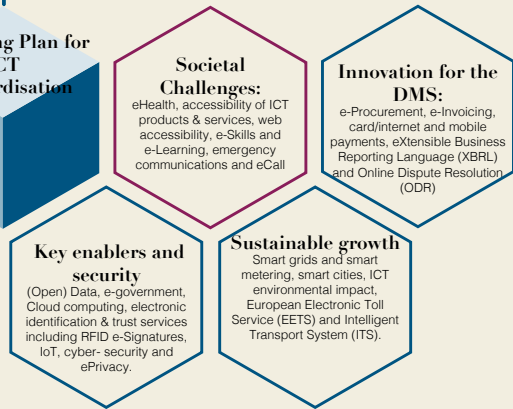
CKAN

Is an open source data portal platform, where you can publish your data for others to use – and you can use the data the whole community have combined. CKAN is the biggest open source platform and used by many governments as well as companies and organizations (20). CKAN is included in the reference architecture of FIWARE (21).

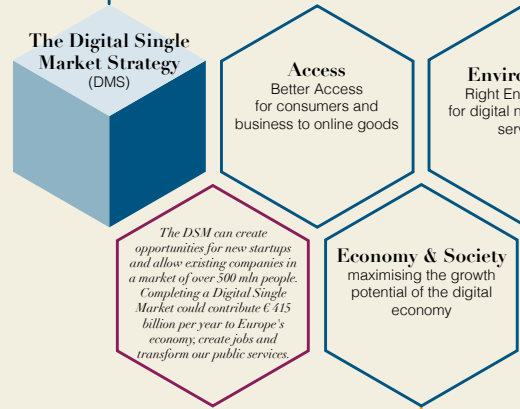


Interoperability standards is a part of an on-going, political trend to enable a pan-European digital market working across national jurisdiction. Creating new job opportunities is a main driver.

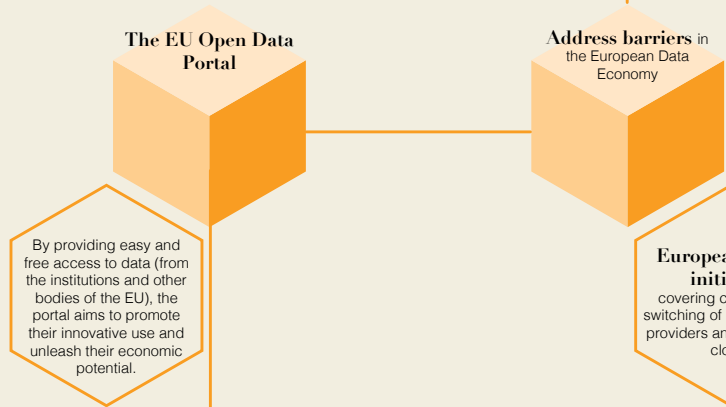
EU Rolling Plan for ICT Standardisation



The Digital Single Market Strategy (DMS)



The EU Open Data Portal



partnership between FIWARE and the European Data Portal



Smart City Politically Business Model Technical



Need for change

OASC, FIWARE and CKAN can all be seen as symptoms of a bigger political trend going on. Digitalization and automation is eliminating more and more jobs, and the political polarization seen in Europe and USA are in part, reactions to that. Many of the social benefits we have seen with globalization is also disruptive to the political, governing and economical model that has run our cities and nations.

Open Data as the business model for the future

In the interview it was stated that creating new job opportunities, enable citizen co-determination rights and making systems that provide actionable output is the key value gain with smart city services. These ideas are not an isolated, Norwegian case - on the contrary, Norway is probably among the better favoured European countries - but something the EU has identified as a major challenge in years to come. They are

therefore putting a lot of effort, research and funding in creating a Digital Single Market (DMS).

Digital Single Market

An estimated effect of a completed DMS is a market with over 500 million people, generating 415 billion euro yearly (22). The Digital Single Market Strategy is based on three pillars. The first one is about better access for consumers and businesses to online goods - making the EU digital world smooth and seamless. The second is creating an environment for digital services by designing rules that match the pace of technical advances. The third is maximizing the growth potential in the digital economy so that the European economy, industry and employment take full advantage (22,23).

These guide rules are launched through funding like Horizon 2020, but also in drastic, new legislative enforcement like **PSD2; Revised Payment Service Directive**. Valid from 2018, PSD2 forces all banks to share their entire costumers account details archive through open API's. In doing so, the EU are removing the banks monopoly on payment services, and enable third parties to build financial services on top of banks' data and infrastructure (24).

Free flow of data, standards and interoperability

Today the European markets are not as connected as the EU need them to be, and the biggest obstacle for that is contradicting nation-wise jurisdiction. Therefore, the EU is working hard to create legal interoperability, data security and free flow of data to enable more actors to participate and create jobs, as well as to change the economy from autonomous home markets to a common European market (23,24).

Environment
networks and
services

free flow of data
tackling data location
restrictions, access and
transfer of non-personal
machine-generated data,
data liability and legal
uncertainties

an Cloud
ative
certification,
cloud service
and a research
cloud

The Commission is
concentrating on defining
priorities for
**standards and
interoperability**

25/01

Meeting with
Ola Eirik
Klingen

50 Citizen Focus

government working together with citizens to realize public interests at the intersection of ICT, mobility and energy

Enabling citizens

with the tools and opportunities to create and problem-solve

Facilitating conversation between stakeholders

so citizens' voices are not only heard, but instrumental in solution design

Citizen City

Figuring out citizen's real needs and making them instrumental in policy making, is coming as an executive order from high up in the political system. EIP-SCC define Citizen focus as a Key Horizontal Enabler in their Smart Cities Strategic Implementation Plan for how to transform into 'Smart Cities'. Citizen City is one of EIP-SCC six action-cluster/ focus areas.

Concrete involvement of citizens needs to start with identification of real needs. Translating them into policies through co-design and co-creation

Smart City Politically Business Model Technical



Smart Cities as moral entities

Creating jobs and ensuring that the economy is fit to provide a livelihood for the citizens, is a baseline of the governmental responsibility. With traditional factory- and manual work declining due to automation and digitalization, the question becomes how do governments adapt to this new world order?

One way is to tighten foreign trade deals and protect existing jobs within national boundaries, the other to embrace globalization and interconnected economies. Both approaches are challenging, and the second offer a lot of uncertainty and unknown terrain.

The DSM is an attempt of the second approach by starting to lay the foundations for a new economic system. But finance aside, the bigger question is of course what kind of geo-political relations the two approaches foster, one focusing on protectionism and the other on a global society with free exchange of services.

In this context, the DMS, open data, free licenses, equal access and connected data economy gives Smart City a flavour of social democratic principles.

‘So, Smart Cities are moral. I like that’

Interviewee

Cities by and for people

With all the focus on creating new jobs, optimizing resource usage and prepare the cities for a new future another vital question is how do you involve the citizens? The European Innovation Partnership on Smart Cities and Communities (EIP-SCC) is also an initiative supported by the European Commission. Its mandate is to address the major environmental, societal and health challenges facing European cities today by enabling innovative solutions that combines ICT, energy management and transport management. To speed up the transformation of European Cities into “Smart cities”, they identified how we include citizens into the process is an integral actor for transformation (25).

Citizens City

The interviewee pointed to the fact that you today have ‘smarter’, but also more demanding citizens. From commercial services and smart phones, we are used to things simply working smooth and easy. By comparison a lot of the administrative chores and public services citizens meet in the governing system is cumbersome and tedious. The need to modernize is something the public sector is becoming aware of.

In addition, the transition to smart cities will affect laws and social structures in a lot of unexpected ways. Enabling citizen’s voices to be heard and instrumental for policy making is something both the EU and the Norwegian government is giving more attention (26,27). From our current social structures, we are used to decision being made and later implemented in society from a top-down approach. In the digital era however, a freer, more flexible form of democratic model might be better suited.

Aligning political decision making, technical interoperability standards and business model structures for Smart Cities

To the right is a section of the Giga Map showing The EIP-SCC's Strategic Implementation Plan for transforming European cities into Smart Cities (26).

The model shows how the topics I discovered through the interview with Klingen and the following research are all connected in a holistic Smart City framework. OASC is an organization working to create a common smart city market, FIWARE and CKAN are interoperability standards utilizing open data, and the DMS is EU's economical flagship for challenges of globalization.

OASC, FIWARE, CKAN and the DMS are all attempts of answering aspects of the same challenges, and fit well into the eight horizontal enablers in this model; decisions, insight and funds needed in smart cities.

Trondheim in Norway, Norway in Europe, Europe in the world

Throughout the giga-mapping the same Smart City themes kept recurring, and they also resonate with the Smart City focus described for Trondheim municipality in the interview. The problems in Norwegian municipalities are within the boundaries of a common, European Smart City framework.

In a bigger picture, with ever-more interconnected economies, technical advances and global challenges the smart city market is also global.

The European Innovation Partnership on
Smart Cities and Communities
(EIP-SCC)



Decisions

Citizen Focus

Policy & Regulation

Integrated Planning

Insight

Knowledge

Metrics & Data

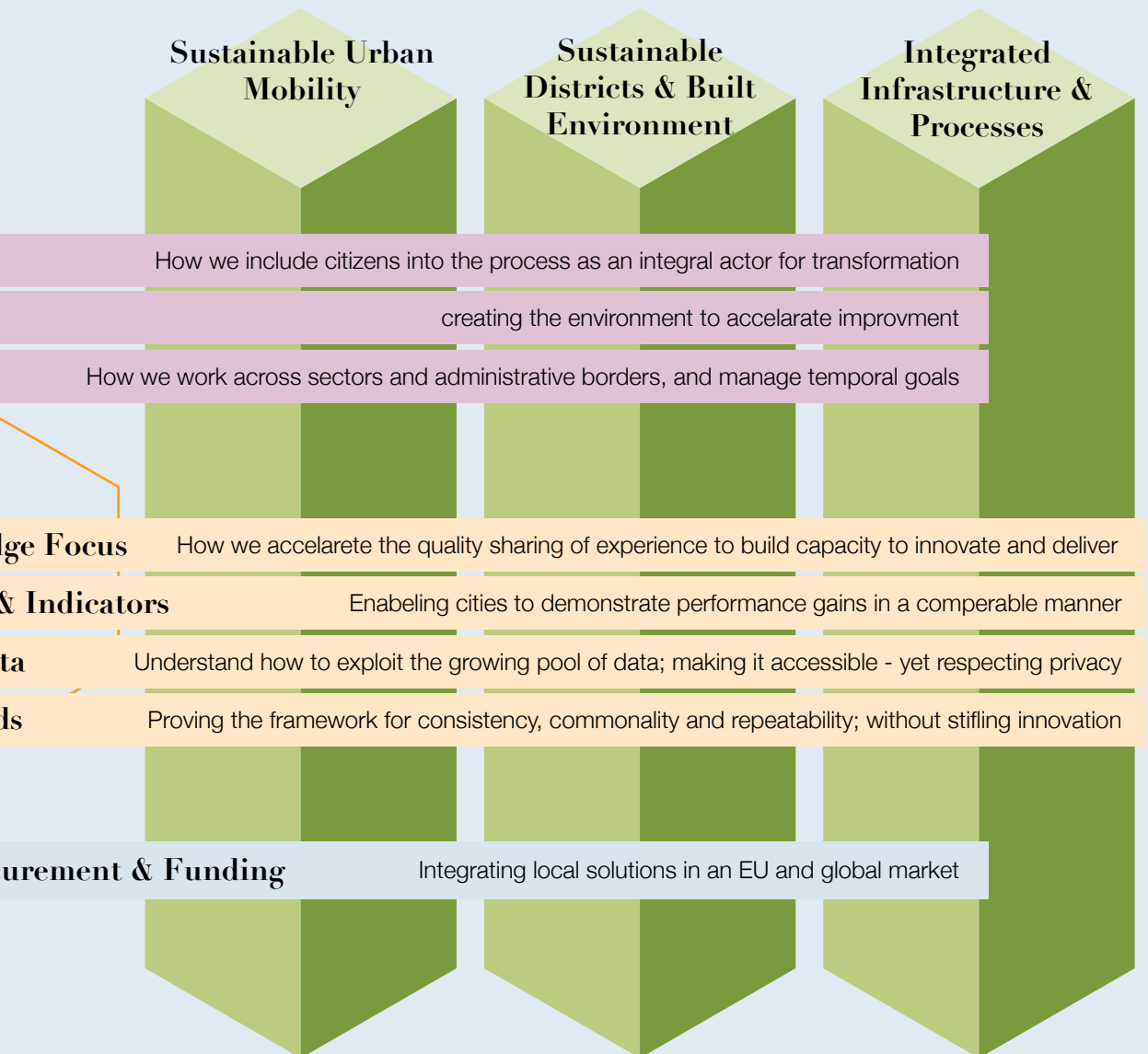
Open data

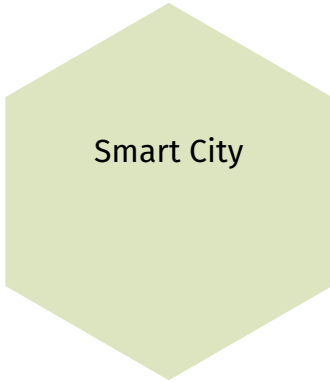
Standards

Funds

Business models, Procurement

The EIP-SCC's Strategic Implementation Plan for transforming European cities into Smart Cities.

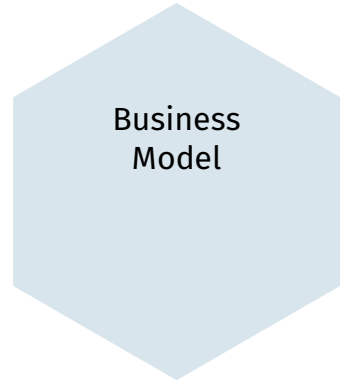




Smart City

Actionable output

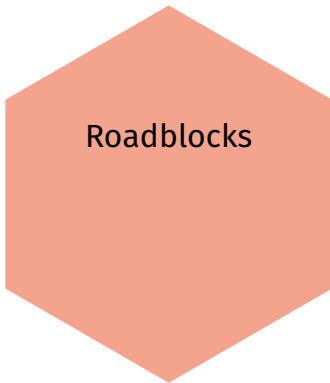
Value of Smart city lies in economy; creating new industry; enable citizen co-creation rights and making systems that provide actionable output



Business Model

SC Single Digital Market

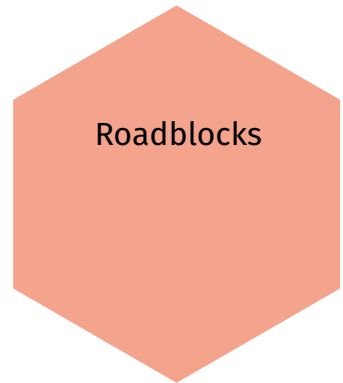
The European Union is working hard to set up systems on how to share data across country borders, through initiatives focusing on free software and standardized API's



Roadblocks

Data restructuring is time consuming

Operation of the municipality itself is challenging and there is always a shortage of resources, both people and money. Overall there is few opportunities and little budget to do the necessary data restructuring.

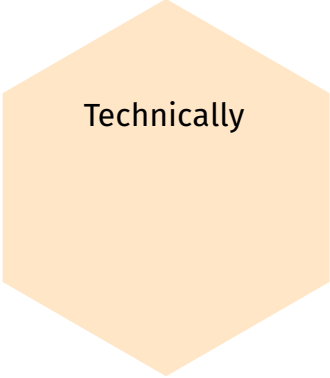


Roadblocks

Open data & Information Security

What are the limits when you release public data? Does it exist guiding and regulations? What is the public law?

The most important clues & constraints from the interview are listed here.

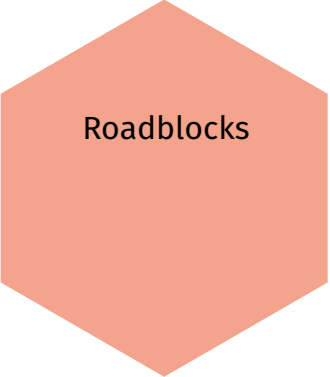


Technically

CKAN & FIWARE

are free-to-use, EU & OASC supported software that focus on providing standardized API's and a common platform to enable a smart city market.

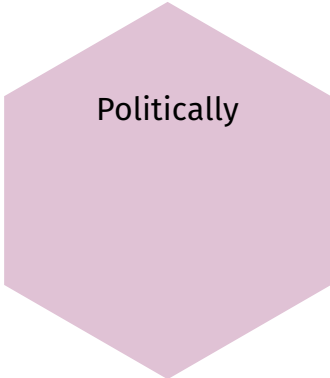
Standardization, scalable software and to avoid vendor lock-in is key for software buyers in cities and municipalities.



Roadblocks

Joint Collaboration

Companies and cooperation partners of the municipality may need to solve problems for the municipality and lead the way in how to technically and business model-wise develop and operate smart city initiatives.



Politically

Actual drivers

in large, Norwegian municipalities for SC initiatives;

- 1) **The green shift**; 'Fluffy terminology; but refers to an idea about acting sustainable' (quote)*
- 2) **Create new workplaces and businesses or keep the ones you have in a new wrapping.***
- 3) **Citizens wellbeing: they're smart, but also demanding citizens***

Economy, Sustainable resource management and Citizens Rights

The emphasis of economy, creating jobs and a Smart City digital market was something that really stood out.

Another, equally important driver was more demanding citizens and their right to co-determination.

What:

User journey/ Mapping 'the process of changing into a zero-emission neighbourhood'

When:

02/02 – 17 (and partly continued 08/02)

Who:

Researchers from FME ZEN and PI-SEC.

Why:

Identify a 'decision making journey' for ZEN and Smart Energy Communities: Who are the stakeholders and what are their pains and gains?

Methods:

User journey/ stakeholder timeline

To get the experts input and reflections on trends and situation that occur in the strategic planning- and building of ZEN's, I used a customized version combining elements from a user journey and stakeholder timeline. Naming the matrix, a 'decision making journey' I first got the researcher to name all the stakeholders, and then pin-point they're main impressions about them. Originally, I wanted to distribute the stakeholder in chronological order along the horizontal axis, but soon learned that when the different stakeholders took part in the process varied greatly, depending if private or public builders initiated the process. Different stakeholders also tended to work in 'blocks' and so we illustrated this with vertical skyscraper where the height depended on their impact in the ZEN process and the inhabitants were the group of stakeholders for example working with 'construction'. On the vertical axis, I had prepared some topics like 'stakeholder main mission', 'pain points' and 'happy moments' to be themes for analysing, but also used the researcher's spontaneous impression to form the themes. The theme 'User insight/ stakeholder view as basis for their decisions' was one of these themes that emerged when the researcher started talking.

Outcomes:

A stakeholder timeline of the decision-making journey in Smart City initiatives. Researchers from PI-SEC has spent a lot of time interviewing stakeholders and identifying the current problems with on-going ZEN initiatives in different Norwegian cities. Based on their analysis and interviews, we made an extensive chart of 'the process of changing into a zero-emission neighbourhood', with a stakeholder timeline on the horizontal axis and definitions of job, focus, beliefs for decisions and typical roadblocks on the vertical axis. In a continuation of the exercise 08/02- 17, three other FME researchers also contributed with their point of view. The exercise revealed many problems within the different stakeholder jobs, but most prominent was the lack of holistic overview and shared goals between the partners.

Timeline

The decision-making journey was made after a series of different meetings. At the Trondheim Smart City dashboard workshop, I met researchers from FME ZEN working on how to develop a citizen-centred architectural and urban toolbox for design and planning of ZEN's. This was connected to a MSc-course where 30 architect students were designing ZEN-like solutions on Kalvskinnet, a plot of land in Trondheim city centre.

Kalvskinnet was also of interested to NTNU Campus development project, who planned to move parts of NTNU university to this plot. On 27/01 - 17 I met with FME ZEN and NTNU's Campus development project.

The meeting was to discuss a dashboard for architects, urban planners, citizens and 'non-expert users' to better plan and create ZEN neighbourhoods. For me, so early in the process, I was curious to learn how smart city initiatives like ZEN was planned and executed.

After the meeting 27/01, we organized the second meeting 02/02 with FME ZEN and PI-SEC to define the current 'decision making journey' in Smart City initiatives.

Results from the user journey

Vertical, not horizontal prioritizing

The main problem was that the decision-making journey was fragmented into different administrative silos. A range of departments from the public sector was involved in trying to define policy and energy regulations for the ZEN's, but they lacked a common unifier to link the process. Because of this, other actors like contractors and architects were also waiting on decisions to be made, and overall the ZEN plan- and building process lagged and fell behind schedule.

How to break down hairy political goals into deliverables?

The different municipal bodies oversaw fulfilling different policies regarding the ZEN's, which caused discussion and delay. The various policies were also difficult to fulfil, since the departments got political goal to meet but not tangible strategies on how to achieve social, environmental or energy objectives.

User not involved

The city planners had in some cases planned urban area usage after more idealistic and democratic ideals ('soft values') about what people wanted from their neighbourhood. This could give very generic assumptions about citizens and their needs. Overall there was definite lack of user insight and citizen's involvement in the planning of ZEN's.

Conflict of interest with other policies

Outside of the siloed actors with concrete involvement in ZEN, you also have other stakeholder with high veto-power but little direct interest. Vegvesnet was one example of actors who could block the whole ZEN process due to their own projects

Lack of long-term ZEN business model

Who have responsibility of what and runs the ZEN after the building process?

The lack of citizen insight

Lack of citizen insight was really emphasised when we continued with the second part of the user journey mapping 08/02 – 17.

4 levels of citizen insight

It was described 4 levels of citizen insight in Smart City development plans.

- **0:** Zero citizen data to base plan on
- **1:** Information about citizen
- **2:** Citizen able to provide input
- **3:** The citizen input was considered when planning

There were also 2 types of data useful for planning of ZEN

Citizen energy data

One was citizen 'energy' data; their movement, transport and total usage of all kinds of energy. Information about this could be extracted by

- deduct movement and patterns of activity based on big data streams. The data streams could for example be from apps and devices the citizens already used
- have sensor installed in the ZEN's; RFID or similar technology to do on-the spot readings
- manually ask the citizens

In most projects today, energy data was often a place between 0 and 1, maybe up to 2 in some cases.

Citizen living data

The FME ZEN researchers also described how another kind of data was completely missing; How are people going to live in the area? On this topic, citizen insight was completely lacking, which aligned heavily with the view presented by PI-SEC from following the on-going ZEN processes. Often the utility companies had a more realistic view of citizen's priorities in energy (simplicity, ease of use, low price) then the municipal planners who in some cases had designed based on more idealistic views about changing citizen behaviour with the right, 'green' motivation. Overall, citizens were not involved in shaping the neighbourhoods.

Citizen involvement should be mandatory

The researchers gave the impression they believed citizen co-creating should be a key element of smart city initiatives. Furthermore, to actual make usable systems citizens would like to use and live in, citizens need to be given a voice on how they wanted it - not only in their energy data and usage, but also in their overall living conditions.

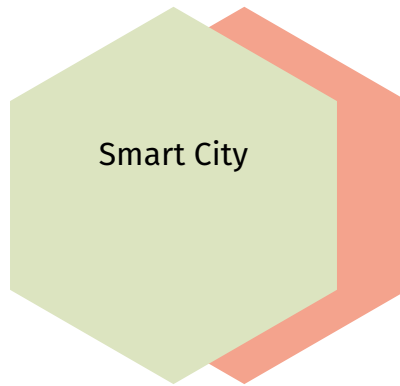
The problem was lack of tools and common meeting ground where citizens and other stakeholders could meet.

Holistic overview is important

It was also emphasised the importance of having 'Smart city ambassadors' within the process. Enova, a state-owned enterprise established to be a driving force towards a low-carbon society, had in some cases taken the role as horizontal unifier in the ZEN process and linking the different administrative silos.

A visual summary of main stakeholders and problems from 'the process of changing into a ZEN' is listed in the appendix B.

60 *The most important clues & constraints from the decision journey mapping*

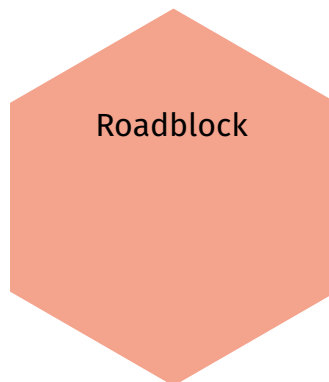


Horizontal unifiers are important

(but currently there's administrative silos)

The importance of having 'ambassadors' within the process, to unify the different political and administrative borders is important..

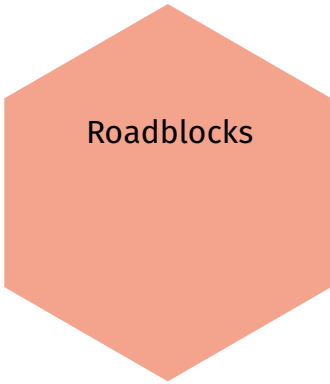
Currently there's a vertical chain of command instead of horizontal unifiers. For everyone involved in the process, it is important to know who are the other stakeholders and what are their responsibility. Process lack momentum and gets delayed because of fragmentation in decision making and lack of common consensus on method and prioritizing



Measurability is difficult, but goal and aims is not a strategy

hairy political goal about acting more sustainable miss an actual breaking down of targets on how to do it. 'Reduce greenhouse emission by 30 % by 2030' can be given as an obligation to the municipalities, but it is up to muni-environment departments to define how to cut (mobility; energy source, more bicycles?) and how to measure & compare (using energy stats from ...? energy source more sustainable compared to what?)

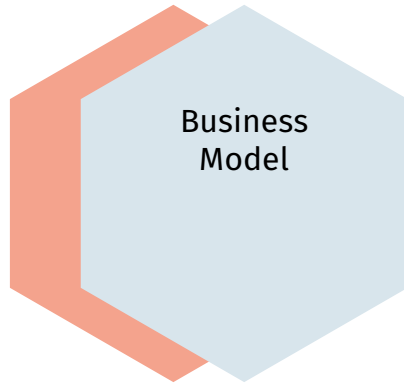
Even if national politics in Norway and over-state institutions like the EU understand the importance of investing in ICT, energy, transport, built environment and so - that's half the job. The steps between vision in high politics, and strategy; business model, responsibility and why to change in all structures of the private- public governance is currently missing.



Roadblocks

Lack of affirmed business model

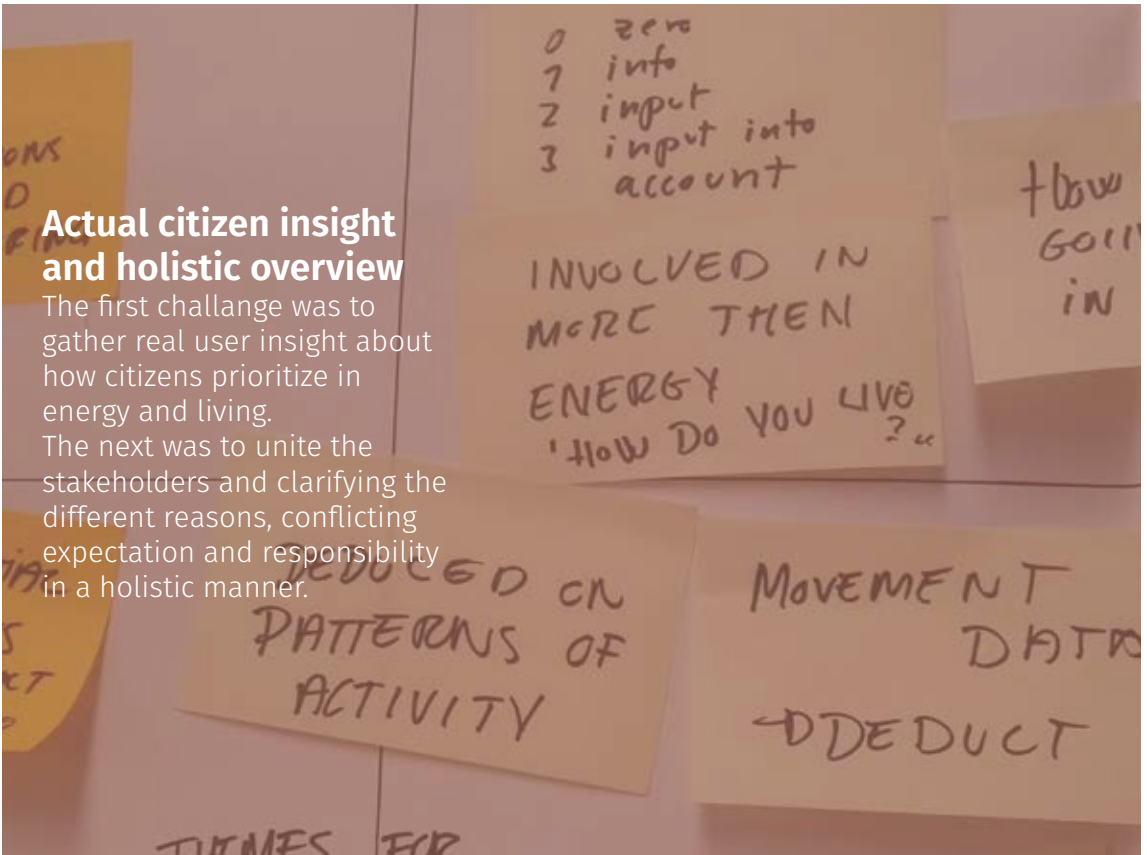
Who are 'urban decision makers'? who operate and manages a ZEN after construction and building is done?



Business Model

Citizen insight is vital (but currently lacking)

To make usable systems, citizens need to be given a voice on how they wanted it. Currently both energy data and citizen living data is missing. City planners sometimes base area specification on ideas about what people want, more the actual insights. It is counterproductive to design for an ideal client, but are smart city initiatives currently more aimed for a homogeny mass of people?



Actual citizen insight and holistic overview

The first challenge was to gather real user insight about how citizens prioritize in energy and living. The next was to unite the stakeholders and clarifying the different reasons, conflicting expectation and responsibility in a holistic manner.

0 zen
1 info
2 input
3 input into account

INVOLVED IN MORE THAN

ENERGY

'How Do YOU LIVE?'

How GOING IN

DEDUCTED ON PATTERNS OF ACTIVITY

MOVEMENT DATA

DEDUCT

TIMES FOR

A teal-tinted photograph of a workshop. In the background, several people are visible, including a woman with long dark hair on the left and a woman with blonde hair in a bun on the right. The ceiling has a grid pattern. The text is overlaid on the image.

From a Citizen perspective

A workshop with 30 architectural students on how they see their neighbourhoods from a citizen's perspective

What:

Workshop: neighbourhood from citizen perspective

When:

08/02 – 17

Who:

30 architecture students from the MSc course 'emission as design drivers.

(FME ZEN researchers for the continuation of ZEN 'decision making journey')

Method:

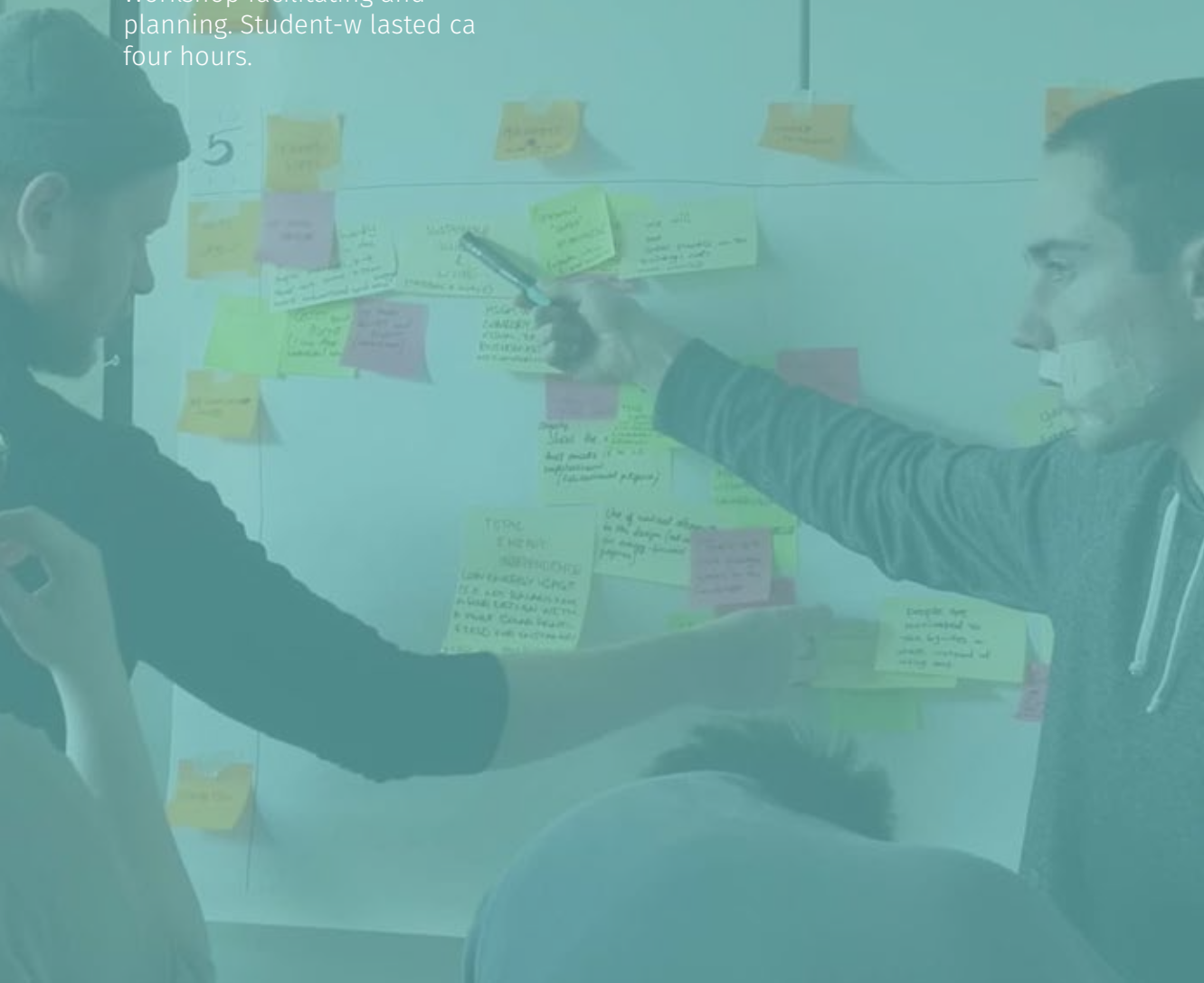
Workshop facilitating and planning. Student-w lasted ca four hours.

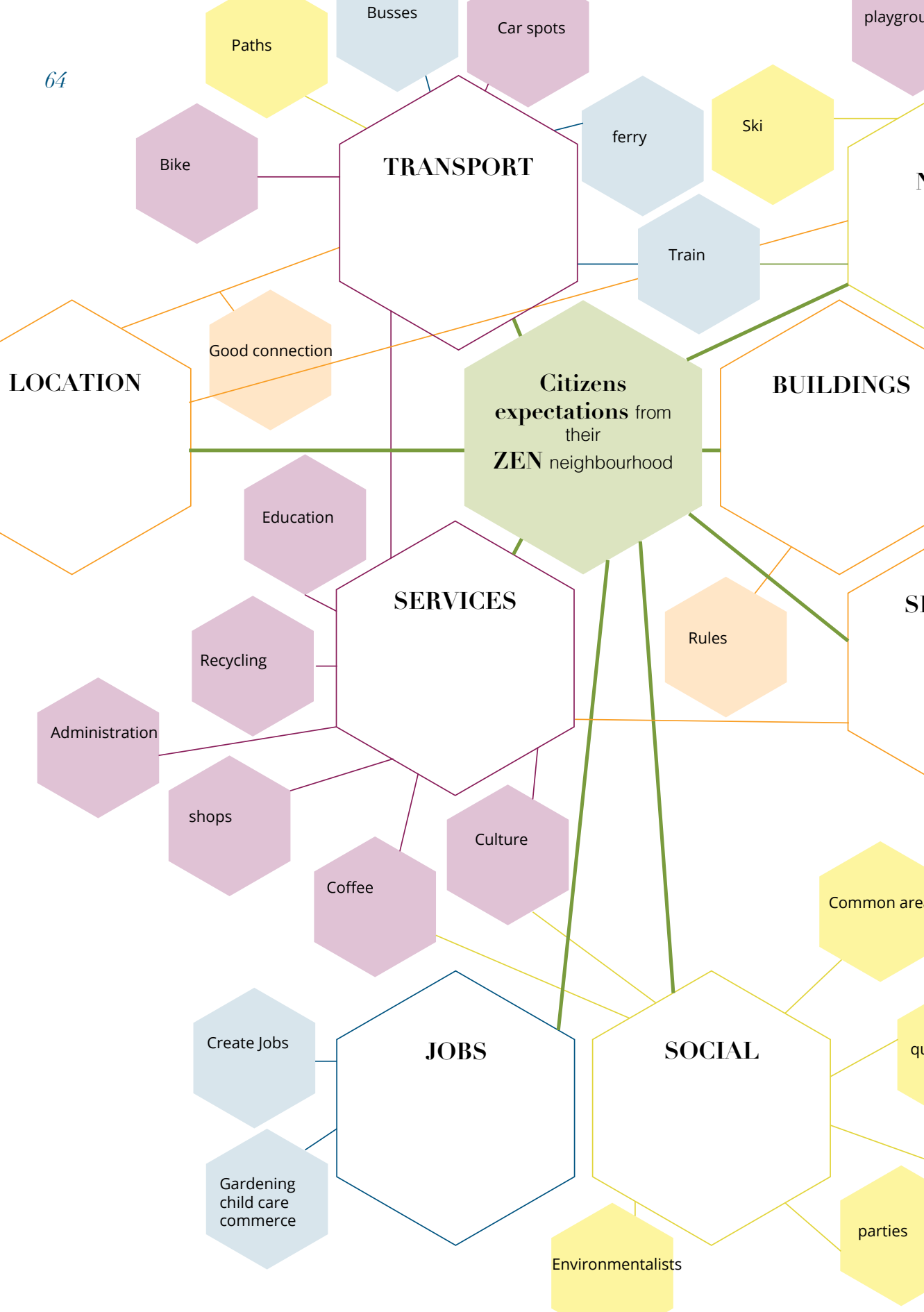
Why:

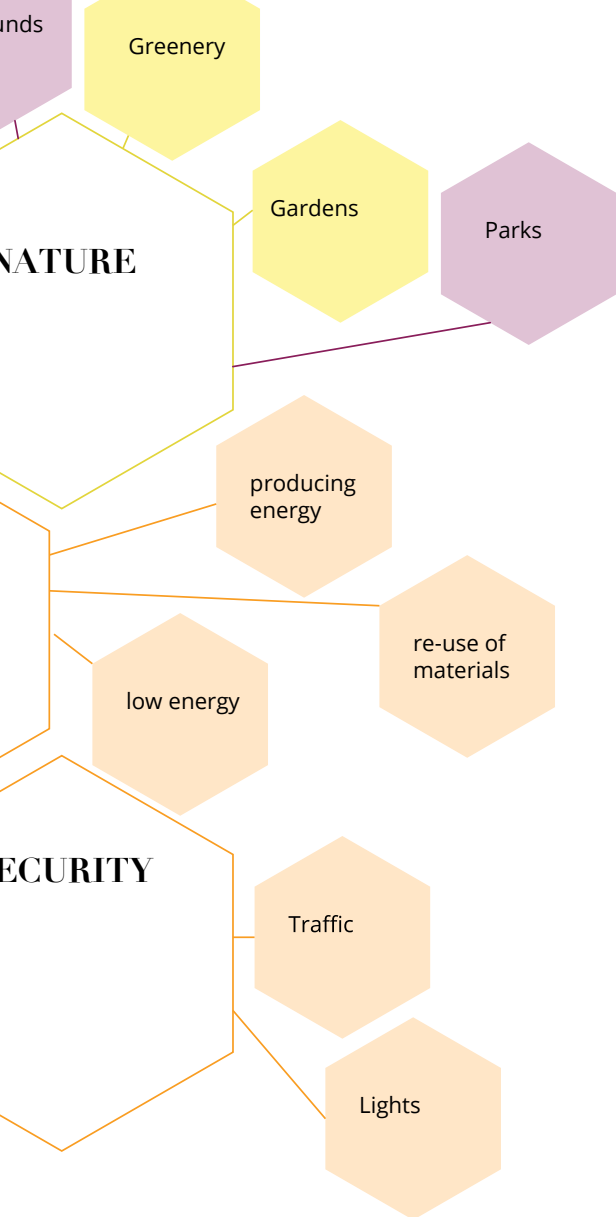
For the 30 architecture students, I built the workshop around the already generated information from the 'decision making journey'-map, but with focus on Zero Emission Neighbourhood from a citizen perspective.

Outcomes:

5 presentations and group overviews of neighbourhood from citizen perspective. Their definition of a citizen's neighbourhood was partly mapped according to expectations and who they thought would be the appropriate service providers.







Key points

- Citizens expect more, see neighbourhood across administrative borders
- Include private enterprises like coffee-shops, stores and shops into the 'public sphere'
- Put themselves in the center, expect services to be taken care of by 'the public'
- put their daily life in the middle, revolves the neighbourhood around
- include non-tangibles like security, quiet, events, parties into the public responsibility
- See neighbourhood in a further sense, including jobs, childcare, education
- wants to be able to influence their lives in the neighbourhood (but 'hassle-less', relate to the public governance in a convenient, easy way)
- reducing energy usage must come as a natural way of living for them. And it is important that they are individuals, not generic stats like 'woman 18-24'

Results

From the illustration of one groups 'neighbourhood from a citizen perspective' it is clear that it contain a lot more then only 'hard facts' about the operational run of the area. The neighbourhoods social sphere stretches far over the geographical situation of your house, and the "public sphere's" responsibility for you as a citizen is fluent and incorporates all aspects of life like ensuring you get a job, have child-care, maintain peace and quiet but still giving you the possibility to cultural experiences.

What one sees here, is 30 citizens expectations of a neighbourhood and connected public service providers that revolves around a multitude of individual lives and priorities. In their expectation from a zero-emission neighbourhood, they have included aspects of location, security, social, jobs and nature as equally important as more standard 'sustainability topics' like transport, building and recycling.

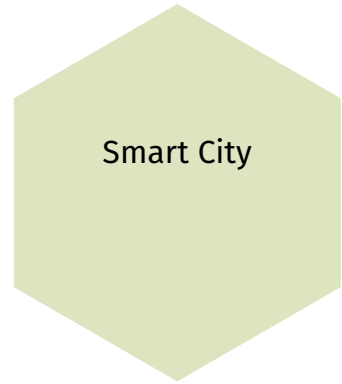
The most important clues & constraints from the workshop is listed here.

Citizens need to be involved, but it is difficult to cater for individual needs

If people define public responsibility and neighbourhoods on a city scale by including jobs and child care, it points to the conclusion that smarter energy use and sustainability also need to be integrated into people's lives, and not the other way around. Trying to design energy- and mobility systems on a city and neighbourhood scale, and then afterwards expecting people to adapt to them 'correctly' the way they were intended, seems naïve.

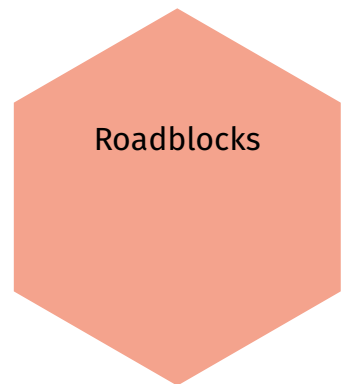
For Smart City initiatives, it is a genuine need to invite people early into the process and gather real knowledge about citizen priorities before, during and after implementing a new social structure.

Here a conflict arrives, because at the same time it is difficult to cater for individual needs when so many of our public service systems is based on making equal solutions for the average of the populations. It becomes a conflict between wanting to view Smart City as urban ecosystems vs people live random, casual lives.



Citizens City is above administrative silos

The public sphere is fluent from a citizen point of view. Their neighbourhood revolves around them, and the expected services around their needs and life stage/ wants, needs and individuality shapes the expectation. Who and what partake in the 'public sphere' is also fluent, and can be coffee shops, ski-tracks, child care and administration.



How do citizens contribute?

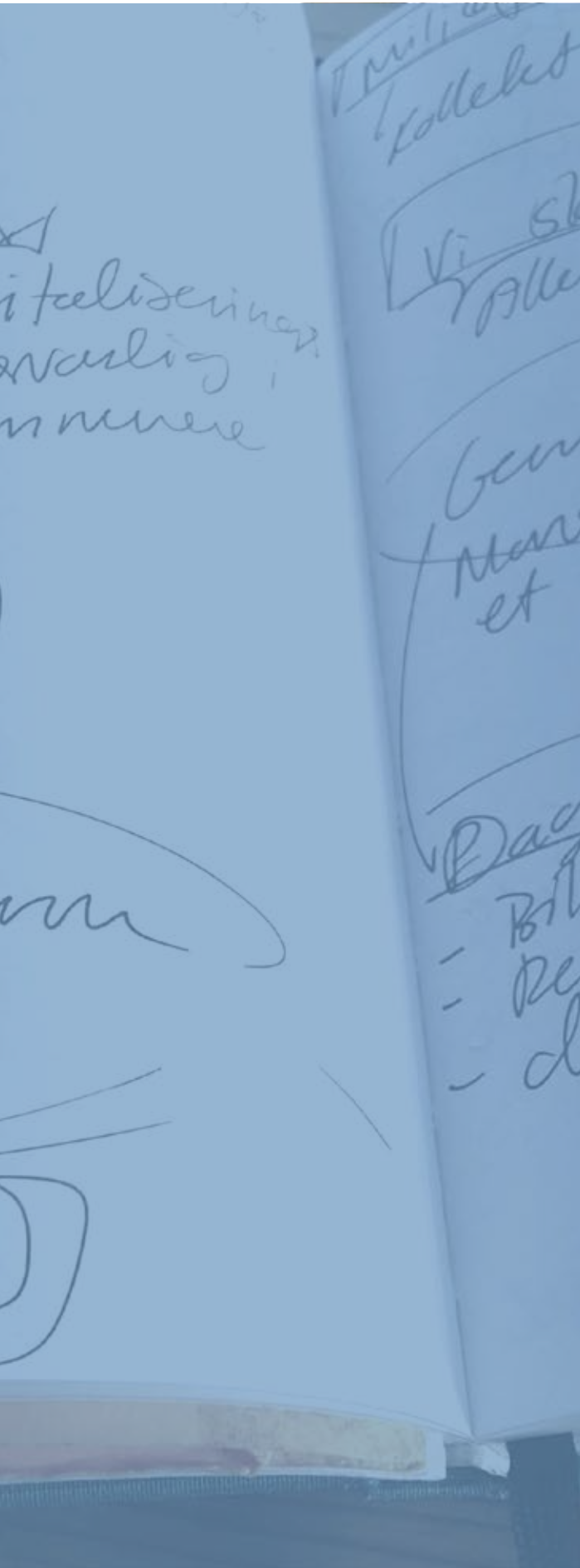
What are the channels between citizens and 'the public'? How can urban decision makers listen to citizen's views if the citizens care more about simply living their life?



Smart is a strategic not operational focus

Interview with Sales Manager in Powel
Water about selling 'smart' software
in municipalities

SMART ⇒ IT-Vision

**What:**

Semi-structured interview

When:

20/02 – 17

Who:

Sales Manager Water, at Powel AS

Why:

Learn about Norwegian municipalities and the potential for smart city/ smart community services today.

What does digitalization mean to different sized municipalities and what are the challenges / opportunities today when selling software to them? How is the focus on digitalization and resource-logging?

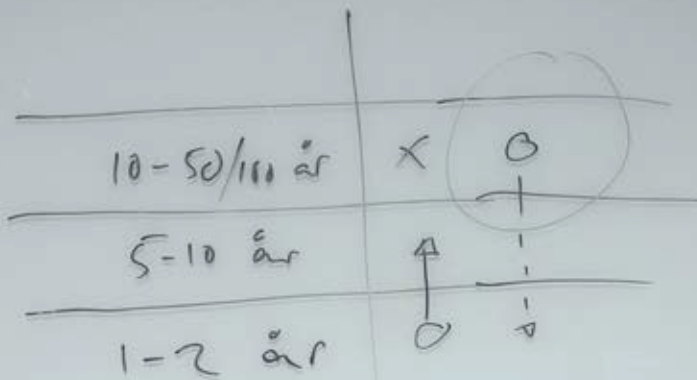
Methods:

Semi-structured interview. Same method as explain previously with the ICT-adviser interview.

Outcomes:

‘Smart’ in Norwegian municipality is mostly a vision amongst the IT-responsible in the governance, and not for the operational units that handle water, electricity and all the different resources in day to day operation.

There is increasingly more political will and demands to log all data for a better overview and potential smart use in later application, but the municipalities often need help to define what, how and why they must document their work.



- MAT TIL SYN (VANNKVALITET)
 - ↗ ØKENDÉ
 - Stort
 - naningens middel
- BREDD / VANNFØRBYING
 - HVER MANGE U VANN
 - HVER LENGDE 6-11-
 - (KOSTRA) → STATISTIKK.

Strategic visionaries

The Powel sales Manager described that the people interested in 'smart' software were strategic staff, often higher up in the leadership of the municipality.

Amongst the Powel Water sales managers, they had noticed that it was easier to sell the benefit of Powel's software that

focused on data collecting when a strategist higher up in the municipality administration was present at the meetings. They tended to know more of the long-term political and operational plans of data collecting, then the ones dealing with the daily run of domain specific sectors like water.

In the picture (and below) one can see how the interviewee evaluated the IT-focus in municipalities.

Municipal scale of data-vision vs yearly outlook

1-2 years: not interested

5-10 years: somewhat interested

10- 50/100 years: 'smart' visionaries

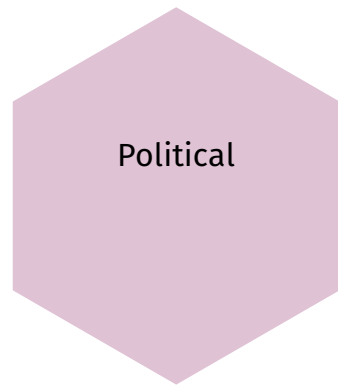
The Sales Manager made an illustration showing how the strategic, 'smart' data focus tended to go top-down in the municipality, starting with people looking 25-50-100 years ahead.

The less of a long-term vision the people needed to have in their job, the less they tended to care about smart use of data and how to optimize resource management. On the other hand, the more operational understanding was bottom-up, starting with the ones having a quarterly outlook until the next follow-up of required data submission.

Operational units cared about software that could help them perform their daily work easier and more efficient. Their tasks were however, getting increasingly data-focused.

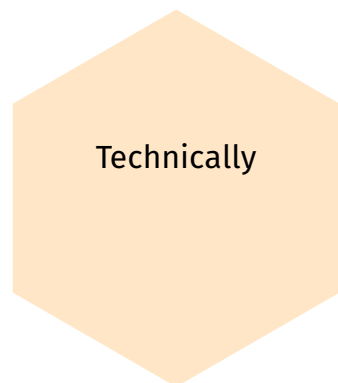
Data logging requirement an increasing trend

The bottom part of the drawing show some agencies that have gotten more focus from the operational units in later years. Instances such as state-owned KOSTRA, which the municipalities are required to report to annually on water quality, status and such, is putting more pressure on the municipalities with new things to report. Monitoring of assets keep getting higher attention from the state, but often lack an explanation to those in operational work about how and why the data are important and can be utilized.



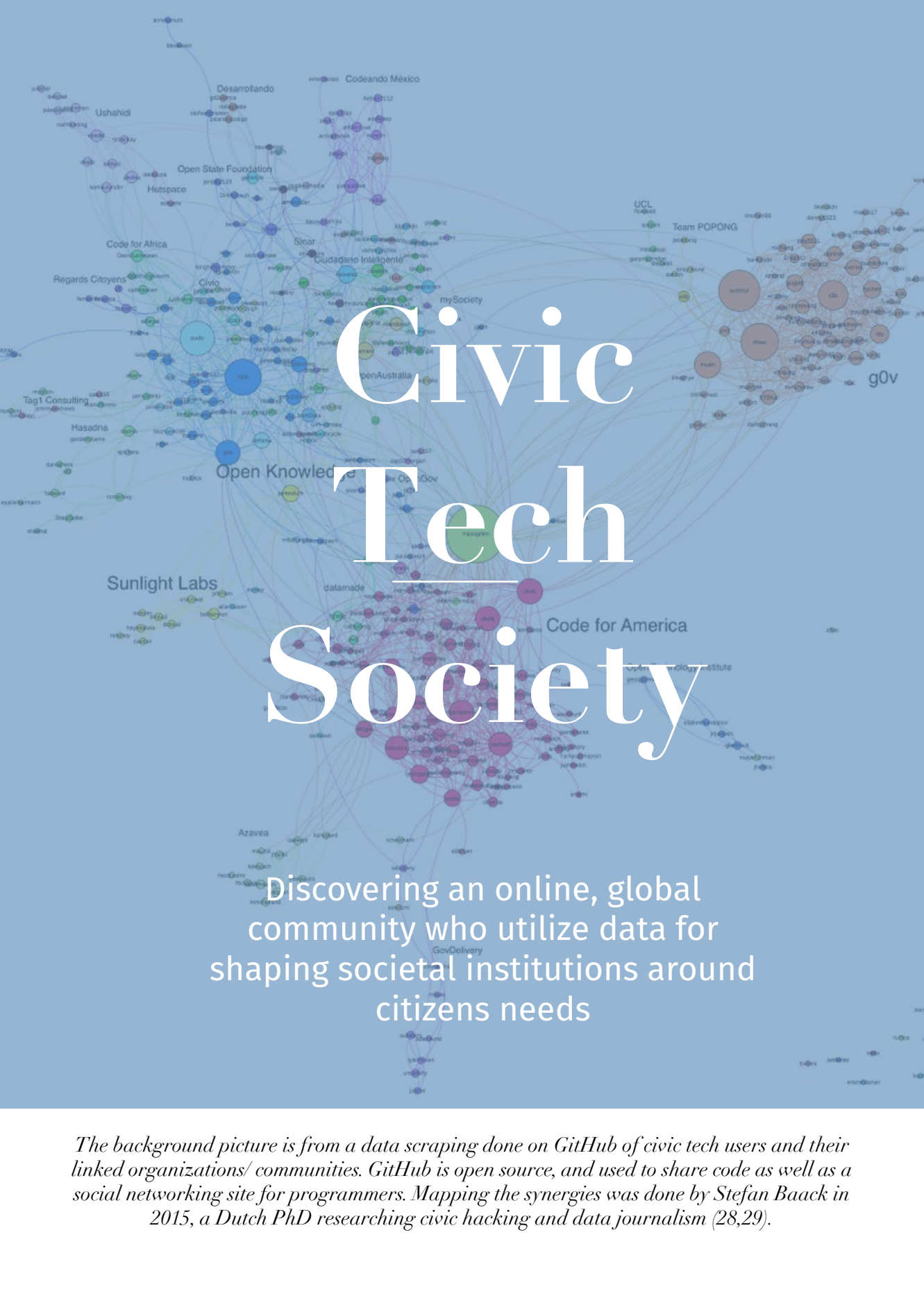
Smart a strategic vision in municipalities

Strategic key personnel tend to have a greater focus on smart data and how operational data can be used to streamline and improve the municipality services



Operational units more concerned with day to day measurements

Increased focus on data logging, but lack an explanation on how the data can be utilized



Civic Tech Society

Discovering an online, global
community who utilize data for
shaping societal institutions around
citizens needs

The background picture is from a data scraping done on GitHub of civic tech users and their linked organizations/ communities. GitHub is open source, and used to share code as well as a social networking site for programmers. Mapping the synergies was done by Stefan Baack in 2015, a Dutch PhD researching civic hacking and data journalism (28,29).

What:

Desktop research

When:

20-24.03 - 17. In addition to more research after the workshop.

Why

In the second part of the research I participated in a master-level, weeklong workshop course arranged by Trondheim Academy of Fine Arts, NTNU. The course was called Art & Technology, and

‘Students participating in the workshop will become familiar with various mapping and visualization tools and platforms (..)

location tracking as a practice within the fields of digital art, literature, and activism’ (30)

Outcomes:

Findings presented in this section comes from exploring location tracking, which led me to a variety of open data networks and the growing civic tech society.

From the previous research, I had learned a lot about the drivers for Smart City initiatives, and how today’s challenges in governance, economy and infrastructure is broadening the scope of what smart cities are supposed to fix. In this second research phase I learned how the ‘datafication’ of stakeholders outside of the

traditional verticals is also promoters for how Smart City is changing from management driven to citizen driven.

What is Civic Tech?

There are many names and different angles for the broad term I identify as ‘civic tech society’.

From my interpretation, I see it as any initiative focusing on improving citizens right, doing public good, creating civic engagement or encouraging more transparency with the help of open data.

The idea is based around data - often open or participatory data - to improve current conditions, and is including, collaborative community focusing on lowering the barriers for data accessibility and innovation in the public sector.

It has its root in volunteers with tech-savvy skills and grass-root civic engagement. Today it has also moved over in journalism, academia, research labs, news organizations, companies and open source programs. I will here introduce some of the terms and actors, although there exist many more.

Data investigative journalism

Is really journalism in the digital world, but follow the trace of data to enhance transparency and hold organizations accountable. It can use mapping, data analytics, data visualization and other technologies to find stories about the people and situations behind the data.

An example of this is the **‘postal big data; global flows as proxy indicators for national wellbeing’**, that used 14 million aggregated postal records from the universal postal union. The data was thoroughly mapped to geographic locations, as new data points were made each time post travelled between countries - revealing that the routes where post move around the world

correlate strongly with indicators of life expectancy and GDP. For the UN this is useful to generate situational proxies of national well-being, as many parts of the world lack digital records (31).

Open & Participatory Mapping

Also called community based mapping, participatory mapping is a way of utilizing modern cartography to highlight the expert, spatial knowledge of communities situated in an area.

Patrn is a data-driven, participatory fact mapping software that is open source and available for everybody, commercial as well as non-profit. It utilizes anonymous contributions to map space and time of an event, and has amongst other things been used for an interactive map of the Israeli attacks in the Gaza attack 2014. Patrn is a forking from **Forensic Architecture** and was initiated with a grant from the European Research Council. It is hosted at Goldsmith, University of London (32).

Forensic Architecture (33), **Digital Democracy** (34), **Igarapé Institute – ‘Fragile Cities: Plotting lesser known urban stories’**(35,36) are examples of organizations using participatory or open data to map human rights, city development or simply documenting facts in a different way. The combination of choosing an event and pin-pointing data location to outline the geographical shape of a problem, is a recurring theme. They work to make visual manifestation of the problem so decision makers can internalize a more holistic view with social, spatial or environmental aspects.

Participatory is the new company policy

The way mapping is crossing from pure volunteer work to research labs and a different kind of business model is worth

noticing. Forensic Architecture is a research agency, linked to their university and exploratory method – but they also undertake advance research for international prosecutors, political and environmental justice groups because they can map complex situations traditional companies do not do (33).

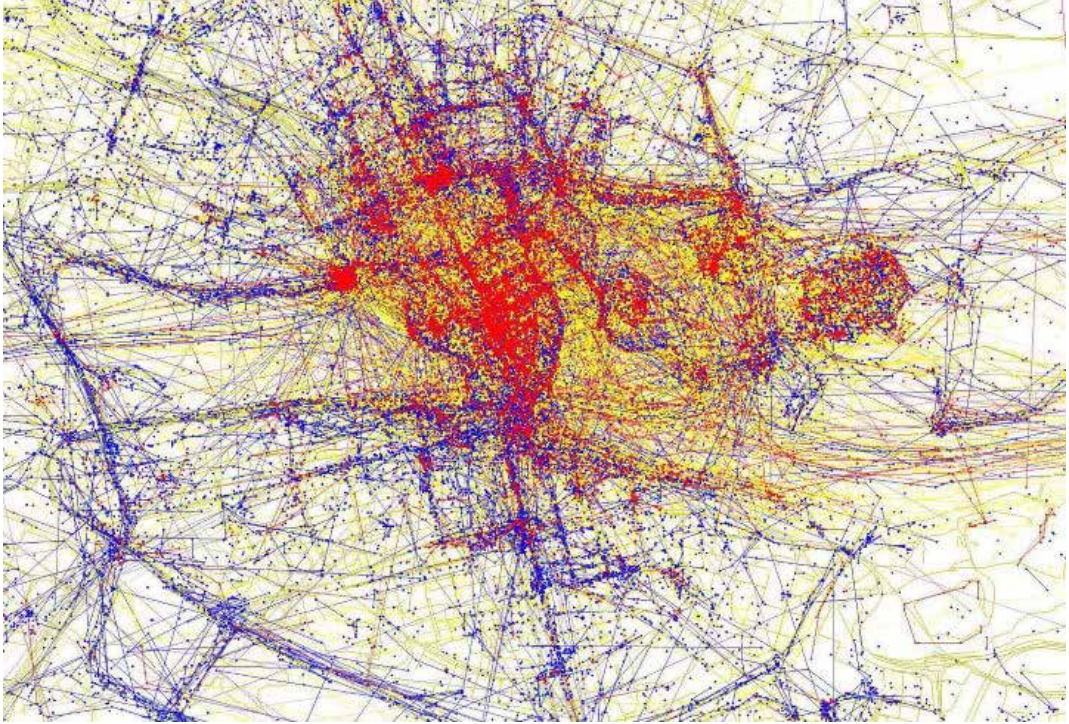
Igarapé Institute promote themselves as a think- and do tank that bring leading decision makers and opinion makers together(35). This way of playing up the iterative, developing aspect of their methodology is a break with traditional business values like stable and reliable. When reading their organization statement, one does not question their desire to truly change existing condition; they come across as team players rather than star pupils that work across and beyond the quadruple helix.

Open networks working with government

There's also networks of people like MySociety, Code for America or Open knowledge.

Open knowledge state they want to make open, accessible information between all parts of society as mainstream a concept as **‘green’** is today (37). They're the creator of **CKAN**, which been used to publish over a million open datasets, along with many other application and events in their global network (37).

Code for America is a network of people with the intention to make the government **‘work for the people, by the people, in the 21st century’**(38). Located in



Stockholm

Geotaggers World Atlas was started in 2010 by **Erik Fischer**. He used Flickr's open API to collect images posted online by everyone around the world, and used their geo-tagged location to generate maps and 'discover the world's most interesting places and the routes that people follow between them'(39). *Geotaggers World Atlas* covers every city in the world, is one man's code, based on a company's open API and the collaborative mapping from people simply going about with their daily business. The picture above is from '**Local & Tourists**' where Fischer over time has used data from Flickr, Picasa and Twitter to generate new urban maps. Deducted on frequency the blue lines are locals, the red tourist and the yellow the ambiguous. Build with the open-source **Mapbox**, *Local & Tourist* also spans the globe(39–41).

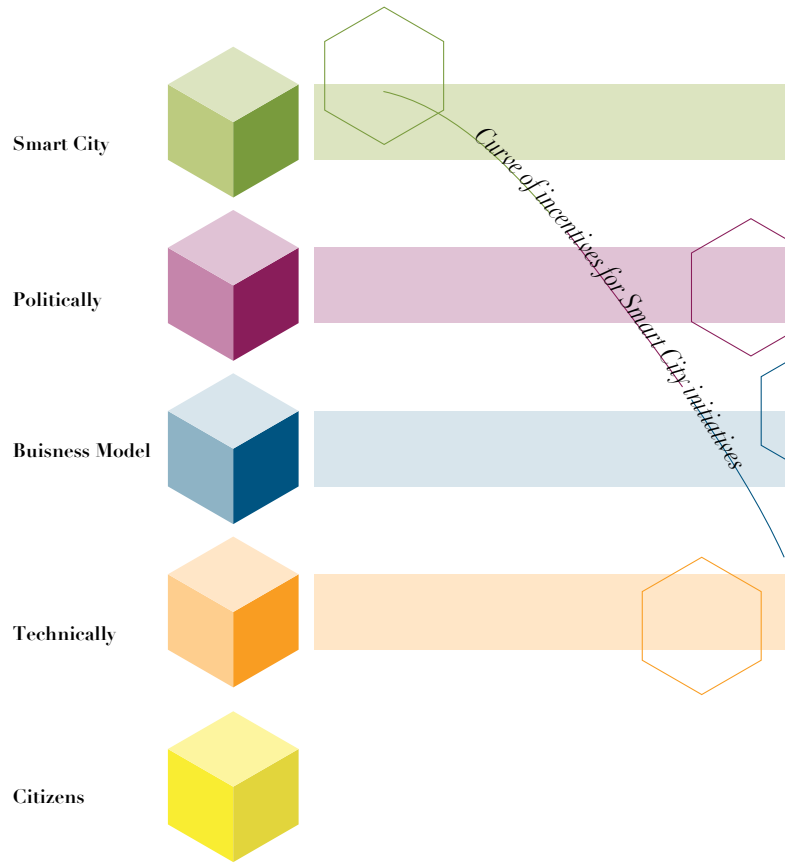
MapIt is developed by the civic engagement group **MySociety**, and is a software that figure out who your representative is based on your street name or postcode. *MySociety* also use *MapIt* in other program like **FixMyStreet**, so that the user can simply type in their case, for example 'tree fell on electricity line' and the program know where to send it automatically. All *MySociety's* work is open source for both government and citizens to set up and is used in over 40 countries(42),



Based on

1. *the structures I'd seen emerged in the giga-map of current Smart City incentives, and*
2. *research into the civic tech society*

I started forming some hypothesis for how Smart City would develop, that's explained in the model.



Currently;

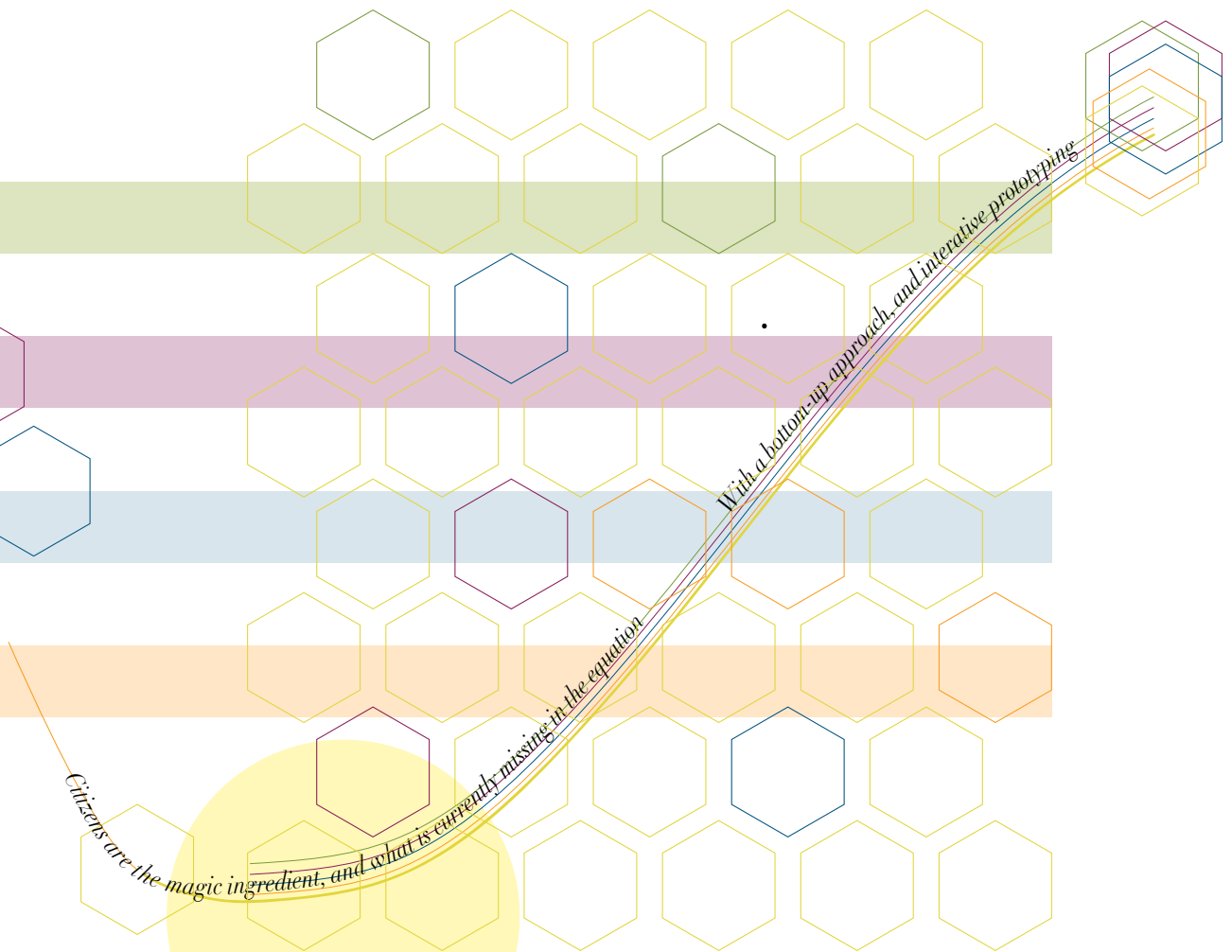
Top-down approach where politically incentives spurs business model incentives spurs technically incentives for achieving Smart Cities.

Continuation of text from last page.

the US, they've worked with over 100 local governments and community organization to enable government services to be within **the digital era; meaning simple, effective and easy to use.**

Over 1000 developers, designers and tech professional have been connected to government and they've developed application like

- **GetCalFresh:** Government food assistance to families in need
- **ClearMyRecord:** Clearing or re-classify low-level, past



Smart City now

What's happening;

A bottom-up approach where citizens direct and indirect choices will influence and steer Smart Cities regulations and initiatives. Developers (public, private, SME's, research and entrepreneurs) need accurate citizen insight to make successful new systems.

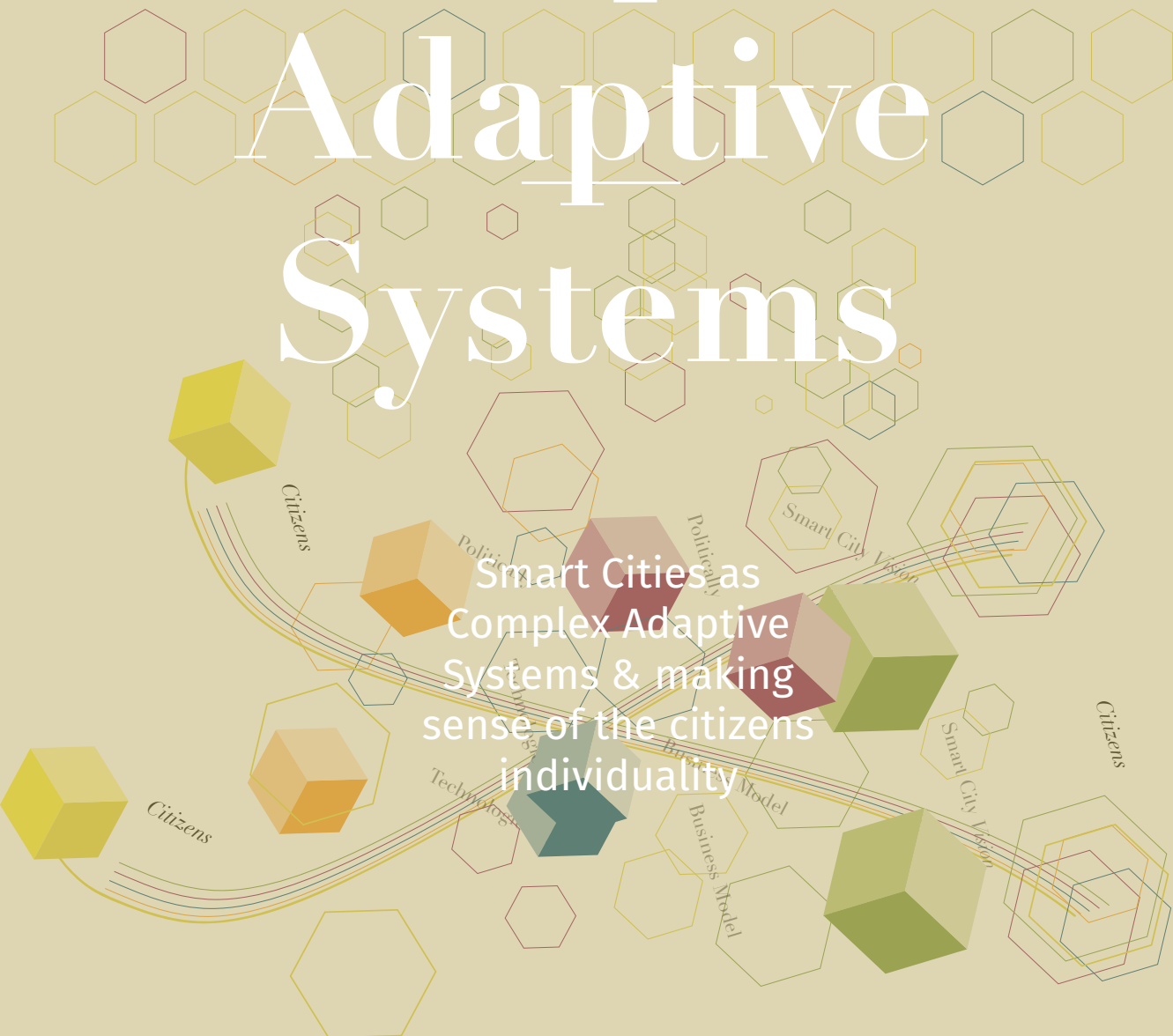
convictions so people can find job and housing, and be eligible for student loans or social services

Open data, open source and standardized format are the technical aspects of what Code for America work for, but they

really champion that **policy must be centred around the needs of people** (38).

Complex Adaptive Systems

Smart Cities as Complex Adaptive Systems & making sense of the citizens individuality



What:

Desktop research and visual explanation models

Why:

After the model of how I saw the future Smart City development, I started pushing the boundaries of how I in the beginning of the thesis had defined very clear roles and categorized accordingly to smart city, political, business model and technical.

Of course, these were still important roles that would continue to push at the Smart City concept from different angles. And they could also be useful hats to sort stakeholder intentions by, but at the same time; the development of smart city was mirroring the complex, intertwined problems it was trying to solve.

Aligning the systemic of smart city to Complex Adaptive System (CAS) explained the fuzzy processes that had emerged better than the linear management approach.

With citizen co-creation stated a strategy from both EU's EIP-SCC and the civic tech society, it was affirmed as a priority from the traditional institutions as well as the new forces in public sectors.

Methods:

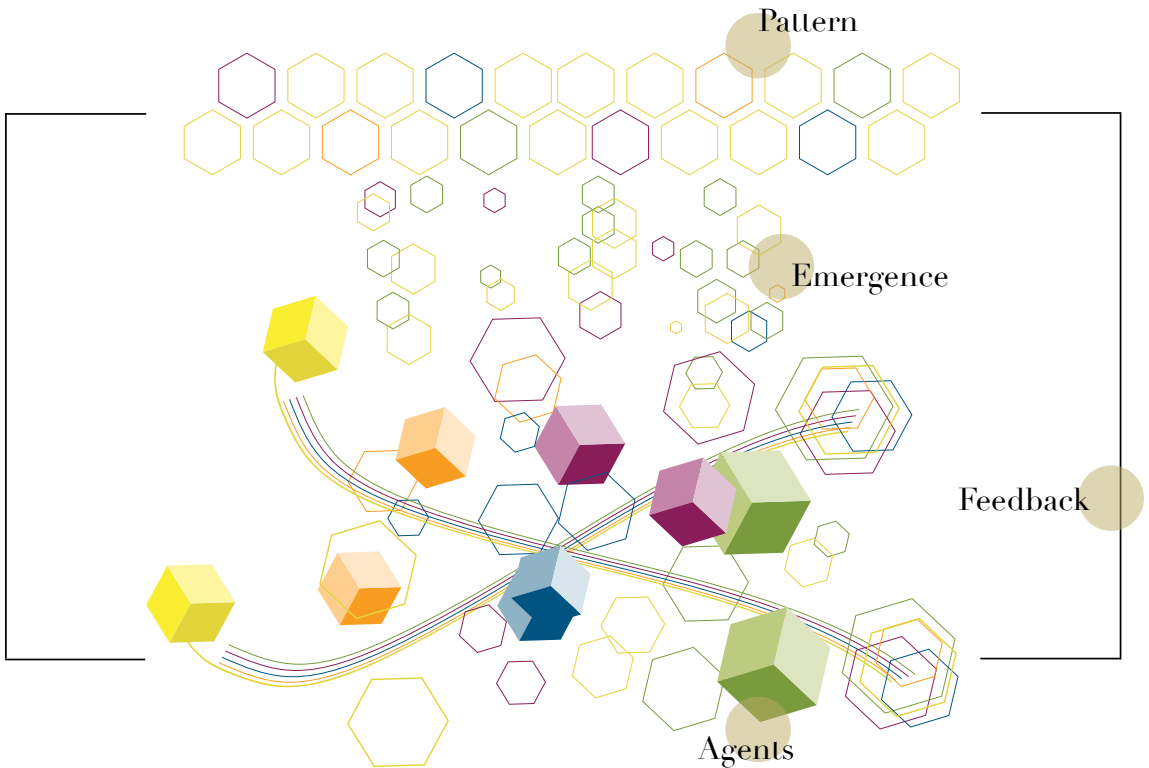
Visualizations & Explanation Models. I used concept models and visualization as a way of defining the frames for my findings. The colour coding from the main giga-map was re-used, but I also introduced a new, equally important factor: yellow for citizens.

Outcomes:

From exploring CAS I also learned about David Snowden and Cognitive Edge (43). Drawing on CAS theory, they have developed a framework for how to quantify micro-narratives (the short, un-complete and extremely human way we interact with each other when we tell a story) to measure emerging trends and pin-point sentiments amongst masses.

Different from social media and big data sentiments, the only bias in this framework was the respondent himself. In one question format, they had utilized exactly this, so the respondent self-assessed his answers. By doing so, one avoided the generic middle-line and population summaries one get from surveys and stats measuring by the average. Instead one could see how people self-signified their own priorities

When aligning the process in Smart City development to CAS, and using the questioning format from Cognitive Edge, I had a structure and strategy for how I wanted to address the problems I had identified during the research.



CAS: A theory based on emergence, patterns and iteration

The same way Helsinki Design Lab identified that our current social structures have left us skilled at engineering solutions, but often unable to see the real and sophisticated nature of the problem - our current social structures have also left us eager to simplify situations into repeatable explanation models. Generic systems and universal truths where cause and affect always follow the same pattern is easier to grasp and consequently easier to engineer solutions for.

CAS on the other hand, does not follow any over-arching law with predictable outcomes. The system explains how you have agents, in this case; citizens, industry, politics, civic tech, technology and many other who affect direct or indirectly our social system. The agents interact with each other, connect and repel in unplanned and unexpected manners and take the many experiences with them when interacting with other agents. This random process is constantly evolving, but regularities will emerge and grow into patterns. This is where the feedback loop starts, because once you have regularities they will inform the agents behaviour, which will again trigger another kind of behaviour. The key factor here is that the agent co-exists and affect each other all the time. They are always adapting to new trends, which forces the system to be in constant

motion. Cities are constantly changing
 When one describe the quadruple helix as the solution for Smart city, one is in short describing a complex, adaptive system. The agents will always inform and co-create new trends for how and why we do smart cities.

A strategy for staying adaptive

This is why the top-down managed approach of developing city systems where policy spurs business, spurs technical solutions and is implemented unto citizens in the last instance, fit very poorly. Smart Cities today are being shaped as circular economies, where governing structures and business solutions needs to stay flexible and work together with the citizens as co-dependent agents. To develop adaptive systems, one need to be able to

1. read the 'citizens city that is above administrative silos', and
2. develop tools that are, in the words of Code for America, within the digital era; meaning simple, effective and easy to use for the citizens.

Although smart cities are seen as offering solutions to pressing global challenges, mainstream strategies do not yet offer an in-depth understanding of correlations and causalities between different urban systems and fail to address the links between 'soft' (economic, ecological and social) and 'hard' (engineered) systems

DACAS, Data and Cities as Complex Adaptive Systems, (44)

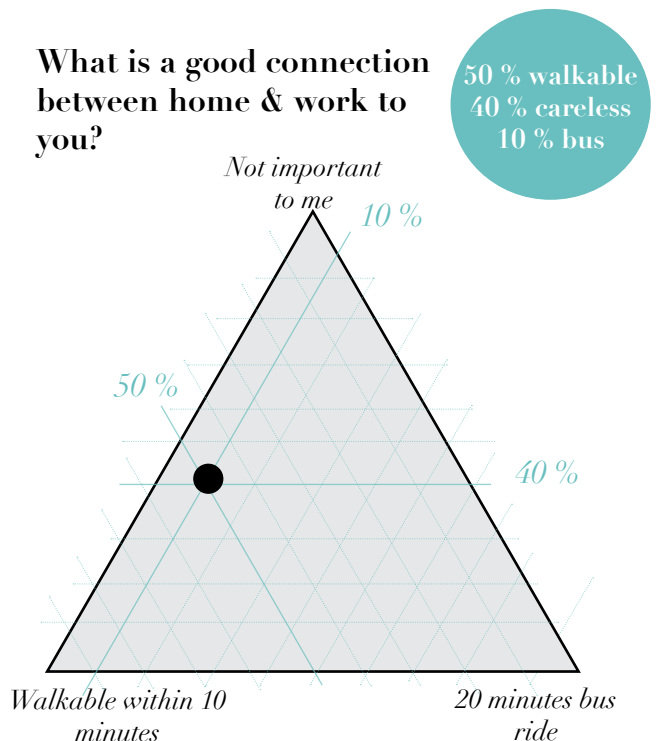
Making sense of complexity in order to act

Accepting that Smart Cities is going to be a challenge to develop solutions for as they're constantly changing, means finding ways to spot emerging trends amongst citizens to inform good decision making.

Below is an example of the triangular question method used by David Snowden and Cognitive Edge in one of their software solutions. I have framed the alternatives to fit mobility. From cognitive science, they knew three options would force people to think more consciously about it, whereas on a linear scale people tend to just place their answer quite quickly. When asked to show where their priorities lies within a triangle, they had observed that people moved the dot around a bit, until they found the spot they felt comfortable with (43,45).

With self-assessing, personal sentiment was quantified into percentage and 'hard facts'. It also reveals contradicting answers, like 'I like to walk, else I do not care about accesability. Bus is not for me' which would maybe not be picked up on in traditional surveys on how important sustainable transport is for you.

What is a good connection between home & work to you?





Smart City Manager

A new role
emerging and the
responsibilities are
holistic, but difficult
to enforce

**What:**

Workshops meetings and visual explanation models

When:

07/04 - 17: Workshop/discussion about 'Big design: initiatives in politics and society', hosted by Big Design & Trondheim municipality.

20/04 - 17: Workshop/ discussion 'Defining the smart city manager role', with the Powel Smart City

Why:

I was invited to both workshops, and the discussions helped synthesise and affirm views about what priorities will be important for Smart Cities in the future.

Outcomes:

From the discussion in both workshops, and the business model canvas we used in the second, I made a summary of key role and responsibility of what we defined as the Smart City Manager. This role is an intended user of my final service concept.



Big Design Workshop

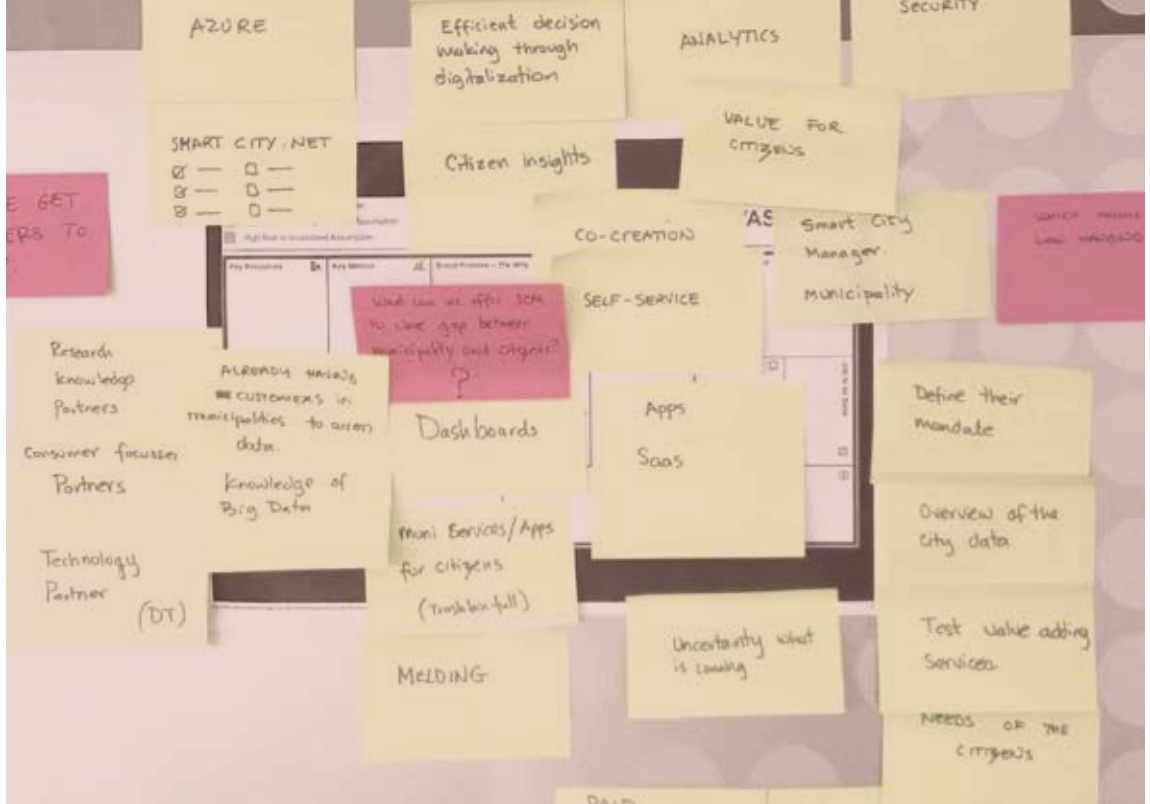
Big Design is a community based in Trondheim, who's undertaking a project from strategists within Trondheim municipality about opening data to spur innovation. Hosted by the municipal partners, they organized a workshop to discuss design thinking in politics and society. On their agenda were questions like; which initiatives must be done in order to incorporate human centred principles in the municipal work, other public sectors and influential businesses? And may this initiative be an independent organization outside of the public administration, or should it be established within the public - or maybe both?

Learnings

The discussion was about what Big design is, how the public sphere is structured now, and if it is possible to predict societal trends to adjust public organization-culture proactively.

Listening to the municipal strategist explain their work, it became clear they had a clear goal about incorporating citizens much more in the daily run and mind-set of the municipality. They were working internally amongst the leaders to promote why the citizens view on the municipal services matters, and how to plan municipal work routines and policy goals to be more flexible.

Many administrative structures were heavy and difficult to manoeuvre, which could make it difficult to change existing procedure. They were interested in new ways of working in the public organizations.



Powel Smart City Workshop

This workshop was initiated because the Powel Smart City group wanted to gather and formalize their combined knowledge about Smart City, into a business concept. I participated, and did not facilitate any of the workshop activities, but will explain how the business model canvas was used.

Business model canvas

Innovation Norway describe the business model as a way to investigate how your company should implement the business idea in practice. It addresses questions as:

- What are you going to deliver?
- Who is the customer?
- Who are friends and competitors?
- How do you sell?
- How do you get paid?
- How do you deliver?

The business model canvas (BMC) is a way to identify customer segments, value promise, channels, customer relationships, revenue streams, resources, core activities, partners and costs (46). In the workshop, we used it as a discussion platform, were we iteratively pinged ideas about what smart city was now, and where we thought it was going. It was a method to concretise a potential business model in an early phase.

Learnings

In the business model, we identified needs and 'what's need solving' for the people in charge of bridging the current gaps to future smart cities. We could see that many of the challenges they faced were complex and fuzzy, often dealing with company culture, defining political goal and aims, as well as data interoperability. Based on this we defined the Smart City Manager role as potential market for Powel.

Municipality Strategic Group

Define what digitalization and focus areas means for this exact municipality



Leaders

Educate municipality leaders about Smart City mentality and leader style



SCM

City Service Domains

Operational toolkit for effecient run of the city



Operational Groups

Strategist with many faces



Operational

Budget

Knowledge

Ambassador

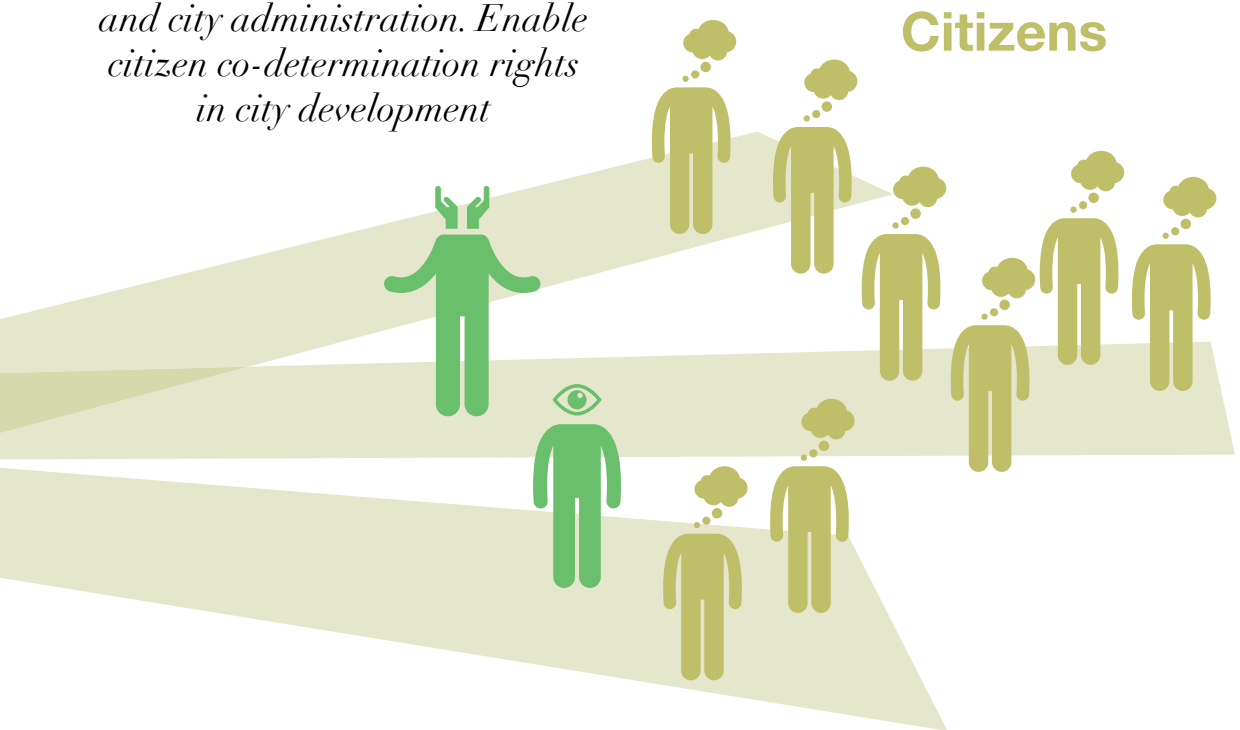
Forward- looking

Visionary

Inclusive

People figurines: Gan Khoon Lay from the Noun Project. Composition: Kristin Rovik Gabrielsen

Close the gap between citizens and city administration. Enable citizen co-determination rights in city development



Above is an illustration of the SMC role, and how it has responsibilities to both the public offices and the citizens. Beneath is the SCM persona created after the workshop.

Role & Responsibility of a Smart City Manager

The Smart City Manager is a role, not necessarily a fixed position. It is an emerging role, but they have a strategic role in bringing across Smart city development in their area.

This requires the city to be smart across all sectors and in cooperation with relevant stakeholders internally and externally:

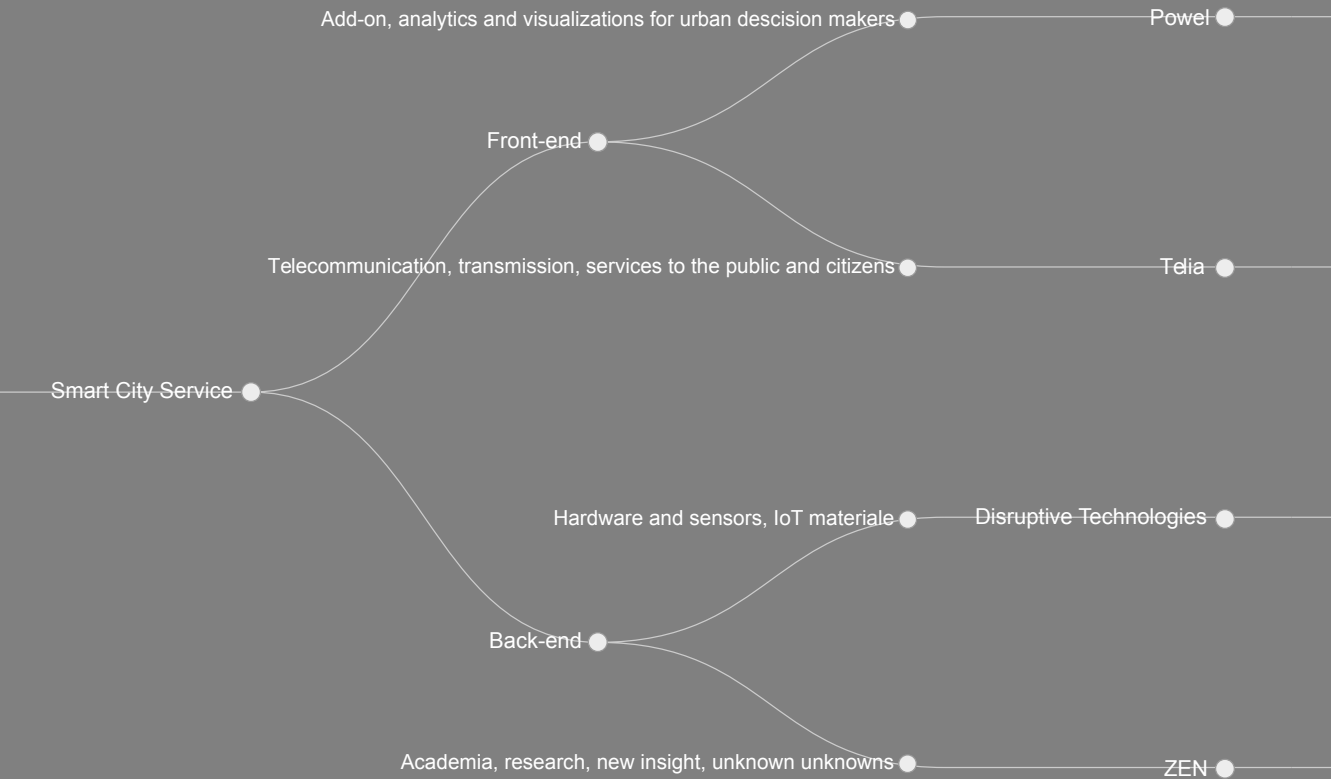
A smart city manager's role varies, and it is a role the person or group has gained in the upper management of the municipality, where he must relate to different approaches, digitization

processes and management levels and find different solutions for different groups.

At the same time, the various initiatives must be brought together under a unified Smart City umbrella, which can also be the SCM's task to define and set the course for in an iterative development process. The position is multifaceted and is increasingly a position that links residents' needs and wishes with the administrative decision-makers process.

To enable a 'Citizens city' is at the heart of the Smart City Managers role.

After the workshop, London has launched their search for a Chief Digital Officer (CDO) to make public services more accessible, efficient, and better suited to the needs of citizens. In the mayor's job description, he writes 'the CDO will have to show leadership across a complex range of stakeholders whilst also understanding where the latest tech solutions can make tangible differences to the life of the city'(47).



New structures

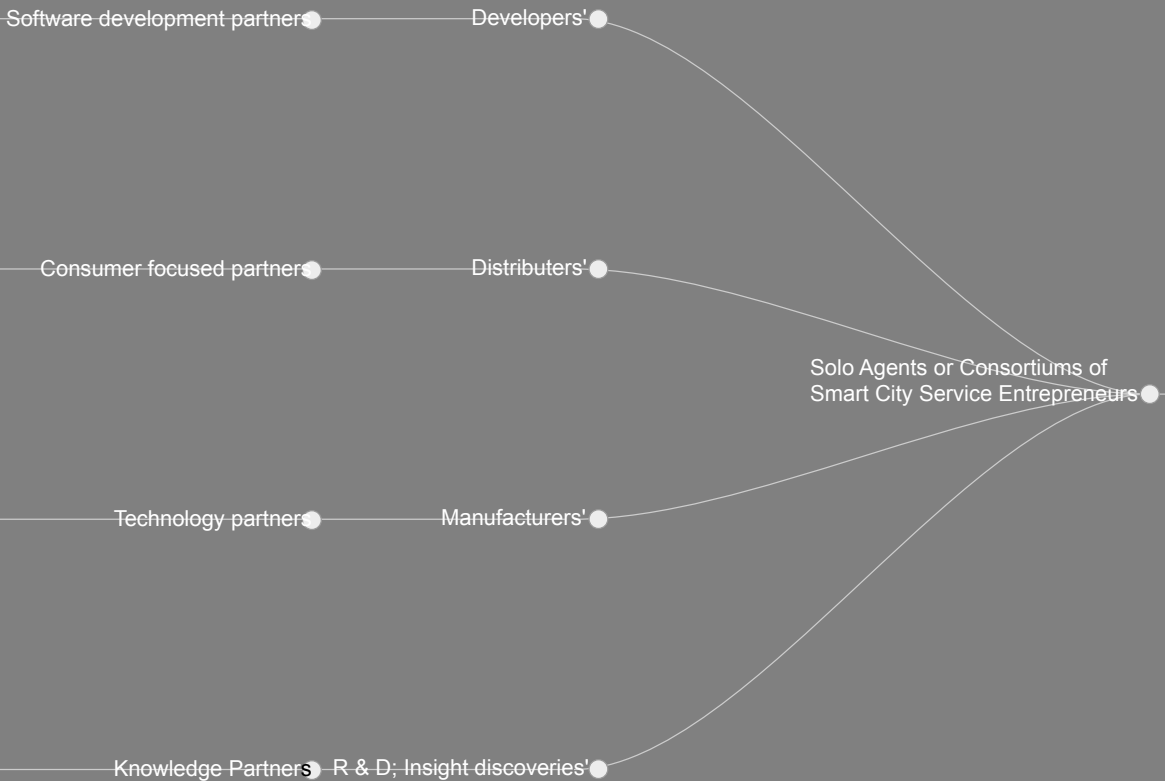
From the Powel Smart City discussion, where we talked about how the old business models are challenged by the holistic approach of Smart City services, I made this overview of a potential, new Smart City business structure.

Smart city has become a description for changes on all levels; innovating, new research in academia, IoT and smart sensors in the public cityscape, ICT, networks, clouds and data interoperability between stakeholders and analytics and visualization of big data to facilitate urban decision makers and better policy making.

This call for a holistic, circular approach when developing new services.

Smart City Service Entrepreneurs :

Model of business structure for a new Smart City market, where companies become 'service entrepreneurs' testing the new market. In reality, collaboration between partners would be more unsystematic than showed in the figure. Natural feedback loops of new development within one area would influence the others, and could go across and form partnerships. It is an eclectic development, with distributed 'business nodes' working together.



New partnerships and potential markets

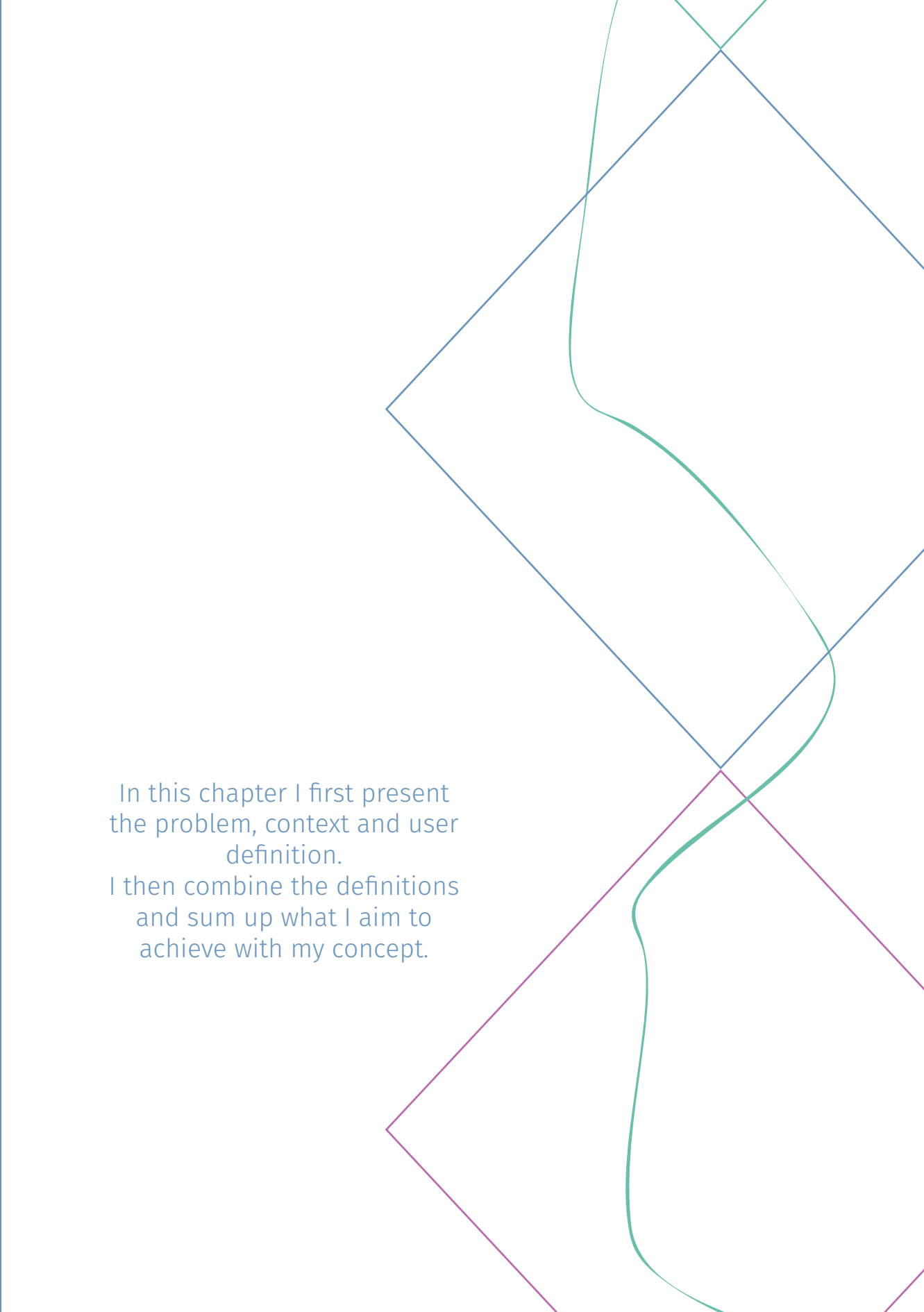
The model is thought of in the following order; a need is identified, a new service needs developing for a city or municipality. The specifics of that service will probably need input from more or all aspects, and fork into the lanes of the figure. Powel is placed within this business ecology, together with examples of other companies dealing with other aspects.

Together they form a distributed ecosystem of partners, that represent nodes in the smart city business network.

Since everybody is figuring out the fuzzy edges of how smart city and the new business model works, my final service concept could also have a market in the other SC partners.

Chapter Three

*Problem,
Context & User
Definition*



In this chapter I first present
the problem, context and user
definition.

I then combine the definitions
and sum up what I aim to
achieve with my concept.

Problem Definition**Smart City term is broadening**

From the desktop research and linkages in the giga-map a larger, multifaceted Smart City started to emerge. Part of a holistic plan, it was addressing how to restructure fundamental systems in our societies

Actionable output

Value of Smart city lies in economy, creating new industry, enable citizen co-creation rights and making systems that provide actionable output

Actual drivers

in large, Norwegian municipalities for SC initiatives;

- 1) **The green shift;** *'Fluffy terminology, but refers to an idea about acting sustainable' (quote).*
- 2) **Create new workplaces and businesses or keep the ones you have in a new wrapping.**
- 3) **Citizens wellbeing; they're smart, but also demanding citizens**

Smart Cities in the big picture

In the first research phase I had many important findings about smart city. Some were about data interoperability and the efforts put in creating common API's and data standards to enable a Smart City market that was big enough for businesses and developers to invest in. OASC, which I had originally focused my scope around, was part of this interoperability aspect of smart city. But because I discovered underlying factors for data standards, I broaden the scope beyond the OASC network.

Part of solution to societal problems

OASC, FIWARE, CKAN and many other open data advocates, were part of a bigger, political movement that saw open data, circular economy, IoT and indeed Smart Cities as a way to adapt societies to the challenges of globalization and more fragile and interconnected systems.

For governance, it was a combination of political polarization, less trust in authorities, rising demand for transparency and effective decision making, more demanding citizens and expectation of better services. This was closely connected to the pressure on economy; automation and digitalization, declining jobs in traditional markets and how data had become an increasingly valuable trade object.

On top of that you had the combination of the need for better resource usage and smarter infrastructure to cater for a growing urban population. Shaping up the economic and social structures to be more sustainable was a driver for better urban mobility, buildings and infrastructure.

The morality angle

The interoperability standards that was in motion were all around open data, open source and free and equal usage for big companies and small entrepreneurs. Seeing that in the current political climate of global connectedness versus nation-state protectionism positioned smart cities as moral entities and democratic concepts.

Citizen co-creation an executive decision

Many of the problems mentioned above came down to how citizens were involved in the transformation

process to smart cities.

In the words of EIP-SCC and Horizon 2020 lighthouse projects: 'The goal is to facilitate a successful transformation towards intelligent, user-driven and demand oriented city infrastructures and services' (48) and 'Facilitating conversation between stakeholders so, citizens' voices are not only heard, but instrumental in solution design' (49).

... and in the smaller picture

From the more hands-on research activities with Norwegian smart city initiatives the problems were more process related.

Administrative silos

Mapping the decision-making journey showed a lot of problems with administrative silos. These took shape in hairy political goals, undefined mandates, bottlenecks and confusion as to who have veto-rights and responsibility of what in the current process flow. The chain of command operated in vertical silos instead of horizontal unifiers linking the whole process.

Need citizen insight

Aside from the fragmentation, the other key point was the lack of decision based on citizen insight. But it was, as affirmed by EIP-SCC a goal for smart city initiatives.

Citizens live random, casual lives

The workshop on zero emission neighbourhood from a citizen perspective identified many individual expectation from a neighbourhood. Naturally people valued personal experiences and which surrounding facilities they wanted differently, but they were very inconsistent about which service provider they felt where responsible for providing the different services. Responsibility, roles and processes in our current public system is difficult to comprehend from both an administrative and citizen perspective.

I had also discovered other topics like lack of affirmed business model or use for a data library, but I deemed these the most important cases to build the problem definition on.

Horizontal unifiers are important (but currently it is administrative silos)

The importance of having 'ambassadors' within the process, to unify the different political and administrative borders is important

Citizen insight is vital (but currently lacking)

To make usable systems, citizens need to be given a voice on how they wanted it. Currently both energy data and citizen living data is missing

Citizens City is above administrative silos

The public sphere is fluent from a citizen point of view. Their neighbourhood revolves around them, and the expected services around their needs and life stage

How do citizens contribute?

What are the channels between citizens and 'the public'? How can urban decision makers listen to citizen's views if the citizens care more about simply living their life?

Problem Definition

How to give urban decision makers a more realistic view of citizen's actual priorities?

Including citizen perspective
is a political goal on its own,
and could act as a horizontal
unifier for the administrative
silos within smart city
initiatives



**Economy,
Sustainability,
Citizen co-creation
rights**

Horizontal unifier:

Unrevealing citizen priorities as a tool unifying the different stakeholders across political, business model and technical incentives

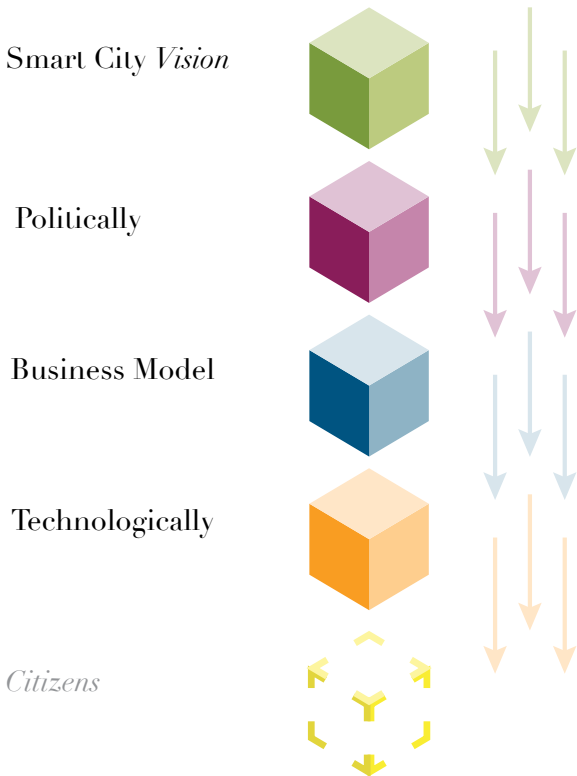
More chance for successful implementation because solutions founded in real, actual needs:

With actual knowledge about how people prioritize, travel and work you have a much better starting point for developing service systems that will actually be used and functioning

Smart City (Iterative) prototyping is inevitable, but just get started already:

Cities are already smart, but a challenge is getting urban decision makers and other actors to extract and utilize the public knowledge that is already available

From; Management driven



Most of the smart city initiatives described in the first research phase, come from a traditional managed approach. It can be illustrated with how political institutions gets approval for funding in for example Horizon 2020 projects, then research centres, universities, private corporations and municipalities apply for project money, then technology gets developed - and when the whole system is tested and proved - it is implemented unto the citizens.

Sometimes the technology might spur a political incentive, a novel law change a business or a new market push the

development of an interoperability standard - but even if it varies a bit in the higher levels of the value chain - it is still a top down approach were managers control the nodes of the network.

The problem of this framework, is it is easy to cast Smart City in the shape of a surveillance system. A city embedded with sensors, with analytics preformed, stored and owned by corporations or the government gives full digital control to only one end of the scale. Even if the intention is initially good; to improve city infrastructure, reduce crime, optimize healthcare or lower emissions - the line between open information systems and full digital control is a fine one (8).

This systemic management of Smart City is part of the problem, as already identified by EIP-SCC. To achieve successful transformation towards intelligent city infrastructures and services, citizens' voices need to be instrumental in solution design. The development must be user driven and knowledge transfer much more citizen bottom-up then it is today.

As described in the civic tech section, change is already happening. Outside of the traditional blocks of decision makers, development with open code, open data and participatory user input is changing many of the default institutions in our societies towards a more responsive system of governance.

In this new kind of citizen driven model, citizens are both at the beginning and end of the smart city vision. Their input is helping to shape the technical, business and political tools to achieve all the things we want; better infrastructure, reduced crimes, better healthcare and sustainable resource use. And as new technology platforms, business and political system are implemented in society in a way citizens agree on, the smart city vision moulds accordingly.

This co-creating method makes the complete difference. Instead of taking the traditional, managed and engineered route where the smart city vision is decided beforehand accordingly to a set 'requirement specification' the results can be evaluated on an ongoing basis. This allow the smart city vision to change and adapt iteratively, fitting the current situation instead of one six years back.

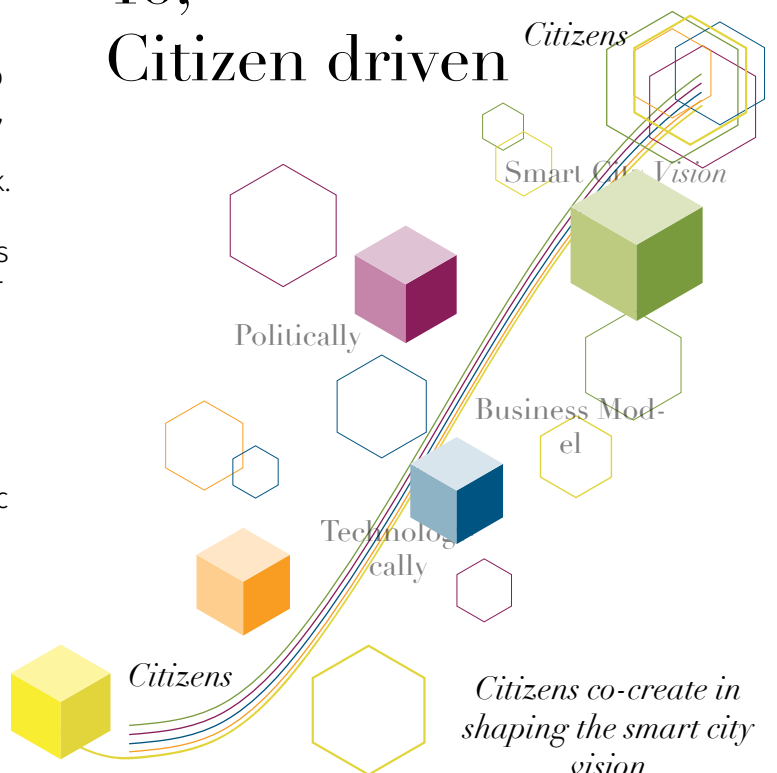
A pillar of EU' DSM strategy is to create an environment for digital services by designing rules that match the pace of technical advances. Technology will develop fast and so will citizen's expectation from their public systems. This is a flexible approach, which allows for a shared smart city vision between public institutions and the citizens and it also fit the idea of SC as moral and democratic concepts.

Solution approach

The citizen's neighbourhood workshop showed that citizens experience of their city is above administrative silos, that is was difficult for decision makers to extract their point of view and that it is important that citizens are seen as individuals, not generic stats like 'woman 18-24'. Implementing the triangular self-assessed questioning method in societies could give more nuances, see conflicting behaviour and priorities and hopefully spot emerging trends amongst the population. To develop adaptive systems, one need to be able to read the 'citizens city that is above administrative silos', and develop tools that are simple, effective and easy to use for the citizens.

The civic tech societies had a way of documenting facts in a different way. The combination of choosing an event and pin-pointing data location to outline the geographical shape of a problem, was a recurring theme. They work to make visual maps and manifestation of the problem so decision makers can internalize a more holistic view with social, spatial or environmental aspects.

To; Citizen driven



Context Definition

Smart City outlook is changing from
management driven to citizen driven

By mapping populations according to citizens self-assessed parameters, one can quantify sentiments and make visual maps of situations to support decision makers and include citizen's opinion in policy and SC initiatives



**Complex Adaptive
Systems, Open data
Self-assessed
priorities,
Geographical
maps of abstract
sentiments**

A way out of the average:

Mapping citizen's priorities and quantifying for decision support, based on the citizens own assessment of how they want to use their time and resources in that geographical area

Visual maps & manifestation of situations

A more holistic view with social, spatial, environmental and other relevant aspects to inform decision makers of current situation. The existing networks and documentation for building maps on open data and open source is sound

No lagging:

Having a way to get situation overview real time, without lagging between emerging trends and information to decision makers

User Definition

Bridging the gap

Linking the bridge between city managers and citizens is really what's at the core of the insights from my research. Bridging the gap is my strategy for unifying administrative silos in current city structures, as well as promoting citizens input in decision making by finding new ways to extract and visualize the 'citizen's city' to decision makers.

Even with citizen co-creating on the political agenda of the movements that fund a large part of smart city initiatives, this is still a very difficult task. As identified from the workshops; what are the channels between citizens and 'the public sphere'? How can urban decision makers listen to citizen's views if the citizens care more about simply living their life?

Complex ecosystem of stakeholders

I've also discovered a very complex ecosystem of different actors in the SC ecology, for me firstly divided into political, business and technical. The quadruple helix is another division model where government, academia, business sector and citizens need to be considered equal players in the innovation system. Citizen initiatives is also coming up as a core player.

And for all the main categories, one have a myriad of lesser nodes within the network. 'Citizens' is divided into roles as neighbours, homeowners, electricity users, workers, commuters, water subscribers, costumers, users and consumer. The 'Smart City Service Entrepreneurs' model is another example of how the categories are divided into sub-categories, which are all trying to

position and find their role.

SCM role

The Smart City manager is a role meant to navigate between all the different stakeholders and their emerging agendas.

His mandate might not be fully defined, but he works across barriers and stakeholder's groups. Internally in city administration he has responsibilities to strategic group, domain leaders and operational service groups. Externally he has the responsibility of bridging the gap between citizens & administration

challenges

A key challenge here is people live individual lives (average does not cut it) and area specific, geographical location. Because successful smart city initiatives are depending on citizen insight and people in a small town of Norway will probably prioritize differently then citizens of London, it is important for a SCM to gather how citizens want to use their time and resources in his geographical area.

In the persona description SCM is defined as working within the upper level of the municipality management. He might also be from a company looking to position themselves as service provider, a private think tank organization working on urban development, a political ambassador or other backgrounds. For simplicity, I will use the problems identified about SCM as a municipality strategist in the argumentation.

Strategist with many faces



Internally in city administration SCM has responsibilities to strategic group, domain leaders and operational service groups

Externally SMC has the responsibility of bridging the gap between citizens & administration

Responsibilities

Define smart city initiatives based on emerging trends

Create citizen's knowledge base to support decision making and policy

Educate leaders about Smart City leader style & mentality /user centred city services

Challenges

Creating the channels

How can urban decision makers listen to citizen's views if the citizens care more about simply living their life?

*In-depth and area specific knowledge
Because successful smart city initiatives are depending on citizen insight, it is important for a SCM to gather actionable data about how citizens want to use their time and resources in his geographical area.*

User Definition

A new role emerging: Smart City
Manager

The Smart City Manager as described here is not a specific job position, but a role constructed in the Powel Smart City workshop. The SMC concept does however, aligned itself to similar ideas.



**Emerging role,
In the middle
of stakeholders,
Diffuse mandate,
Holistic approach,
Strategist with
many faces**

Diffuse mandate that will co-evolve with the role:

The SMC concept aligned itself to similar ideas about smart mentality and a holistic-, interdisciplinary- and humanistic- over technological approach. In October 2015, the Brussels-Capital Region hired Céline Vanderborgh as an actual smart-city manager:

‘What interests me in a smart city is the actual city: The way I see it, “city” should always take priority over “smart”. The challenges cities have to meet are huge: population, resilience, energy, mobility and so on. Technology is now contributing its solutions to these issues via the smart-city approach. test benches where a smart city tests the citizens’ requirements. Sometimes, the citizens themselves test and adopt new platforms which are completely different from traditional services, such as Blablacar, Uber, AirBNB and so on’(50)

Service Vision

From smart use of operational data to smart understanding of the citizens in a city

The aim is to develop a concept where each Smart City Manager in different geographical areas can measure and display what their citizens cares about. It is a


- **digital tool to materialize citizen's opinion**

based on the citizens own assessment of how they want to use their time and resources in that geographical area

- **so decision makers can do more informed decisions**

Chapter Four

*Concept
Development*



With the problem, context and user definition combined into one service vision, a concept was developed and its feasibility tested.

With the problem, context and user definition combined into one service vision, work started on how to utilize the triangular answer method as a way to gather area-specific, self-assessed citizen insight. Below is the concentrated sum up of trying to define a service concept.

Elements of Ideation:

Generate real-time, decision making data about the citizen's priorities in how they mean to live and use the city.

Use city specific insight about citizen priorities to customize smart city business solutions for each city.

Open data

Plan your living calculator;

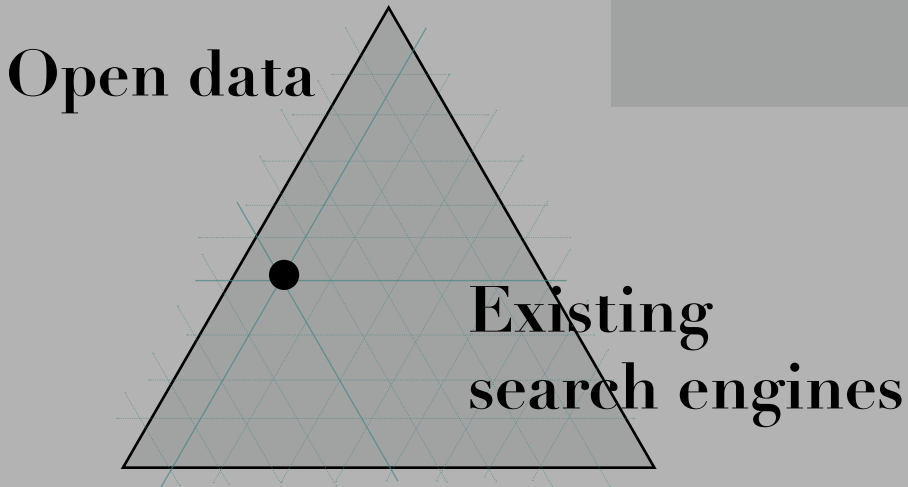
Gender;

Age:

Occupation:

Children:

Have car?



How to do Smart City?

- 1) Smart Cities are changing from management driven to Citizen driven
- 2) Smart Cities are complex adaptive systems (iterative and changing)
- 3) The problem is decision making. The main challenge for each city and town is making decisions in how to do smart city (they need guidance)
- 4) A company which can provide detailed information about the citizens within each city have a huge business advantage (because they have know-how on each city that the municipality themselves are lacking).

Your business has insight? You have power.

Smart City applications will change accordingly to which population, which political goal and which city. Which mean that businesses meant to deliver smart city services in this landscape, must be able to deliver services accordingly to the citizen's priorities and driving forces in each city.

After ideation around the key insight, I came up with a concept involving both SCM and citizens.

The idea was a platform hosted and operated by Powel, which had two interfaces; one aimed at the public and one aimed at a SCM.

Towards the citizens the aim was to extract insights, and towards the SCM to visualize citizen insights in a actionable way. The method for extracting information was the triangular format.

Use city specific insight about citizen priorities to costumize smart city business solutions for each city.

Use citizen priorities insight as a tool when working on the disruptive market changes that is happening within specific domains.

Example; Powel will need to help energy companies with adjusting to the new

The design will have two interfaces;
One aimed at the general public
And one aimed at a SCM or one with similar tasks

The UI towards citizens needs to be easy, quick and user-centred

Probable outlining of the concept UI directed towards citizens:

Content based on open data and citizens has free usage of system

Free software solutions, based on maps and information generated from open data, that citizens can use when they are already in a state of figuring out one exact problem.

Citizens self-evaluation = one data point

They would limited the search scope by a set of parameters, and self asses the importance of the parameters. How they self-asses would not be interpreted by anyone else, machine or people. Afterward, what one would get is one data point about how one citizen evaluate this exact situation in a moment when he cares about it.

Ask citizens in a moment it has relevance for them

The important thing is the citizen would not be doing the task for anyone else then himself. It could be a search engine that is useful for him in the moment, when he is trying to decide on something.

Abstract sentiment is located in the physical world

The self assessed evaluation is geo-tagged, locking the data point to a geographical area. It would work much the same way a app can register your location in the background of the program running, for example using your GPS signal to deduct the best route from A to B

Information anonymized

The self assessed evaluation would be anonymized, so it cannot be associated with any particular individual. Privacy settings are already regulated by law, an will only be strickter in future



*My Trondheim
User involvement in smart
cities*

*Hi, and welcome!
Thanks for taking this
survey*

*'My Trondheim' is a
survey about how people
in Trondheim use their
city and how they want
mobility, neighborhoods
and cityscapes to be linked
together for the life they
prefer*

Test concept feasibility

To test my concept feasibility, I wanted to prove that it was fairly easy to get useful data about citizens, that smart city managers could use. A lot of Smart City data collection these days is focused around sensors, IoT, machine learning or big data streams from for example social media.

Although this is certainly useful, I know from design research that qualitative methods that allow the user to expand a bit more on a subject often tend to reveal 'unknown unknowns' that could end up being the founding insight for your concept.

Questionnaire

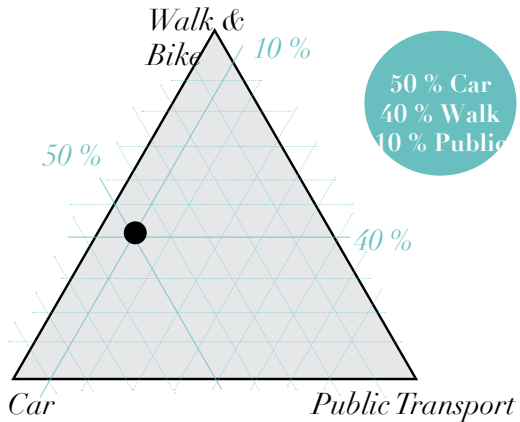
To explore the 'citizen's city'; the one who revolves around how you feel and which stage of life you are in, I constructed a questionnaire to send to people living in Trondheim.

A questionnaire is still a quantitative format, with a set of predefined questions. However, to say something about why people choose to live in a city and how they prioritize when they find a place to live or move around the city, I designed the questionnaire based on the triangular self-assessing format. I wanted to get people to deliberately choose, and position their motivation for living in the city, the reason they chose one transportation method over another and how they experience they leisure time vs obligation time within the triangle.

By doing that the answers where always given in percentage and the priority showed in comparison with the other response alternatives. The triangle method ensure that the dot/ the user position is always 100% of all three alternatives combined.

Another advantage with the question format, is it is quick to answer, and gives the user a visual perception of proportion instead of written numbers.

This is how I originally wanted to structure the answer options. Using the triangle method ensure that the user position is always 100 % of all the alternatives. This shows the priority in comparison with the other response alternatives, it is quick to answer and gives the user a visual perception of proportion instead of written numbers.



To sum up, I wanted to see how much knowledge about people’s individuality and how much of ‘citizen’s city’ I was able to extract from a 2-minute survey.

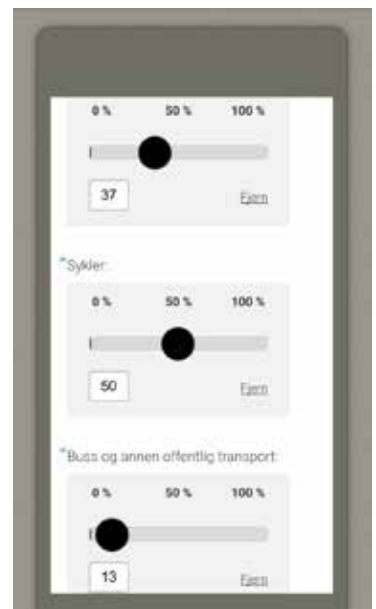
49 valid data points

I sent the questionnaire through email, social media and friends. The survey lasted for a week and in total 80 people answered it. To geographical pin-point where the answers came from, I asked for the participant’s postcode at home and at work/ study place. By doing this, I was also indirectly asking for their most frequented commute route, in case I wanted to deduct something about movement lines in the city afterwards.

Although I spent a lot of time searching for it, I was not able to find an application where I could structure the answers by triangle. In the end, I therefore made the answers alternatives as slide-bars, and wrote that the user must fill out the alternatives so they combined make up 100%. The problem with this was that one could not guarantee that the options combined were 100%. I set the limit for each question between 90 and 100 %, and after verifying the total percentage, plus discarding some answers because the postcode was not in Trondheim, I had 49 answers as a valid data set. Questionnaire is listed in appendix C.

I needed to structure the questions with slide bars since I did not find any program where I could ask in triangle format.

In this exact question, since I was no longer limited to 3 options I divided the ‘walk and bike’ alternative into 2 answers, to get extra info. The user then had 4 options: walk, bike, public transit & car. Afterwards, when reviewing the answers, I could still combine bike and walk to simulate the 3 options from triangle - but I also had specified walk and bike % if needed



The questionnaire was divided into 4 subjects

* Fyll inn de punktene som passer for deg:

Jeg er kvinne

Jeg er mann

Jeg har hjemmeboende barn

Jeg har privat bil

Jeg arbeider/ studerer

Alder:

* Hvor ferdes du mest?

Postnummer hjemme

Postnummer arbeid/ studiested

Personal situation:

The first page identified the person. They were asked to fill in the boxes that were appropriate for them:

Options:

- Female
- Male
- Have children living at home
- Have private car
- I work or study
- Age (filled out manually)
- Where do you travel the most?
- Postcode at home
- Post code work/ study place (filled out manually)

* Jobb og karriere:

0 % 50 % 100 %

* Familie og partner:

0 % 50 % 100 %

* Venner

0 % 50 % 100 %

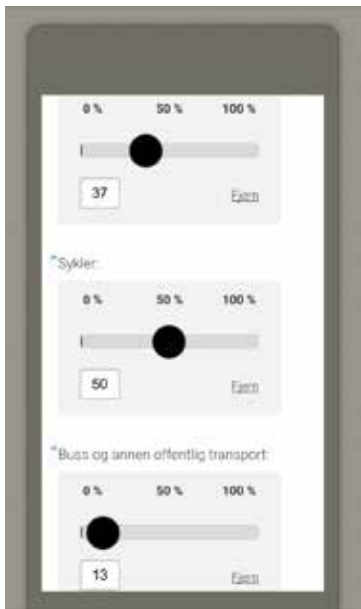
Personality of Trondheim:

The second aimed at figuring out personal sentiments for choosing to live in Trondheim. This was a 'triangle question', where options needed to come in percentage. I divided reason for living in the city as 'personal relations', 'work & career', and 'experiences'. As with the transport question, in this question I split 'personal relations' into 'family & partner' and 'friends' to get more detailed information.

What's your motivation for living in Trondheim? Fill in the alternatives so they together constitute 100 %

Options:

- Work % Career
- Family & Partner
- Friends
- Experiences (nature, culture, hobbies, new opportunities)



Movement patterns in Trondheim:

The third was divided into 2 triangle questions. The first one asked for preferred transport type, the second for the motivation for transport type.

Which mode of transport do you use most?

- Walk
- Bike
- Bus & public transit
- Car

How do you prioritize in relation to the mode of transport?

- Saves time
- Economy & price
- Experience of health, flexibility and other personal reasons



Daily life in Trondheim:

The fourth was also divided into 2 questions. The first one asked what you prioritize having near your home, the second for how you characterized your time usage.

Fill in the boxes of the things you prioritize having within 15 minutes' walk from your home

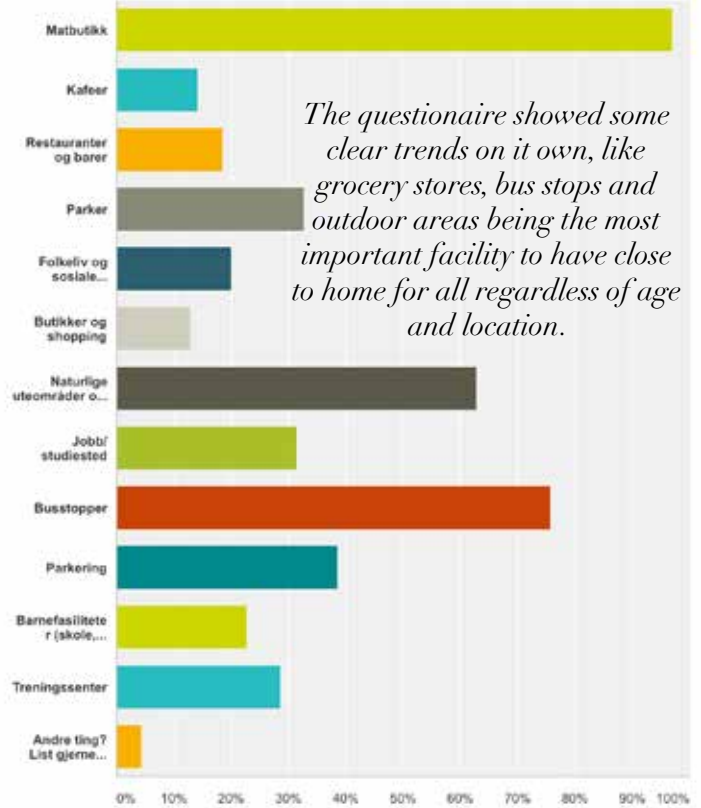
- Food stores
- Cafes
- Restaurants & bars
- Parks
- Public life and social meeting points
- Shops & stores
- Natural outdoor areas and hiking trails
- work/ study place
- Bus stops
- Parking
- Children's facilities (playground, school etc. ...)
- Gym
- Other things?

How would you characterize your time usage?

- Impulsive & spontaneous leisure activities
- Daily commitments
- Planned leisure activities

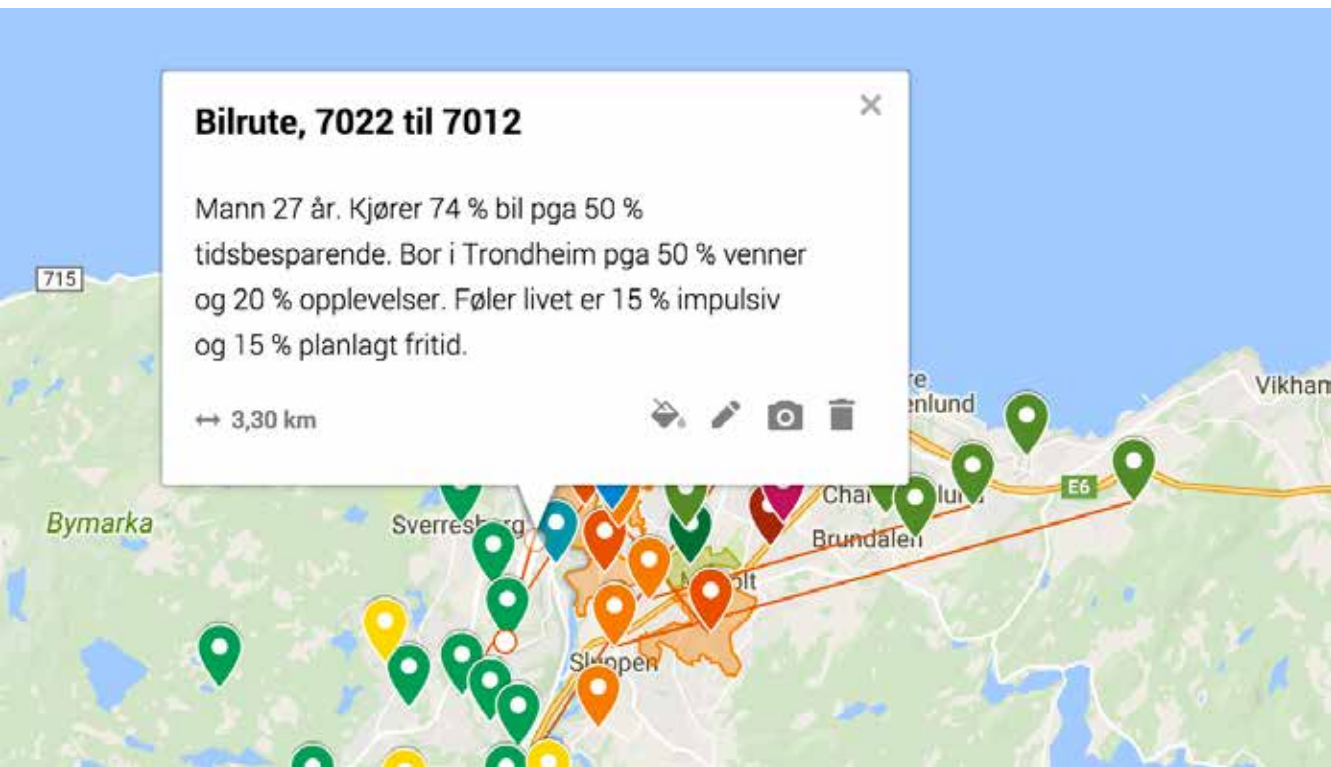
Testing how to make the data come alive

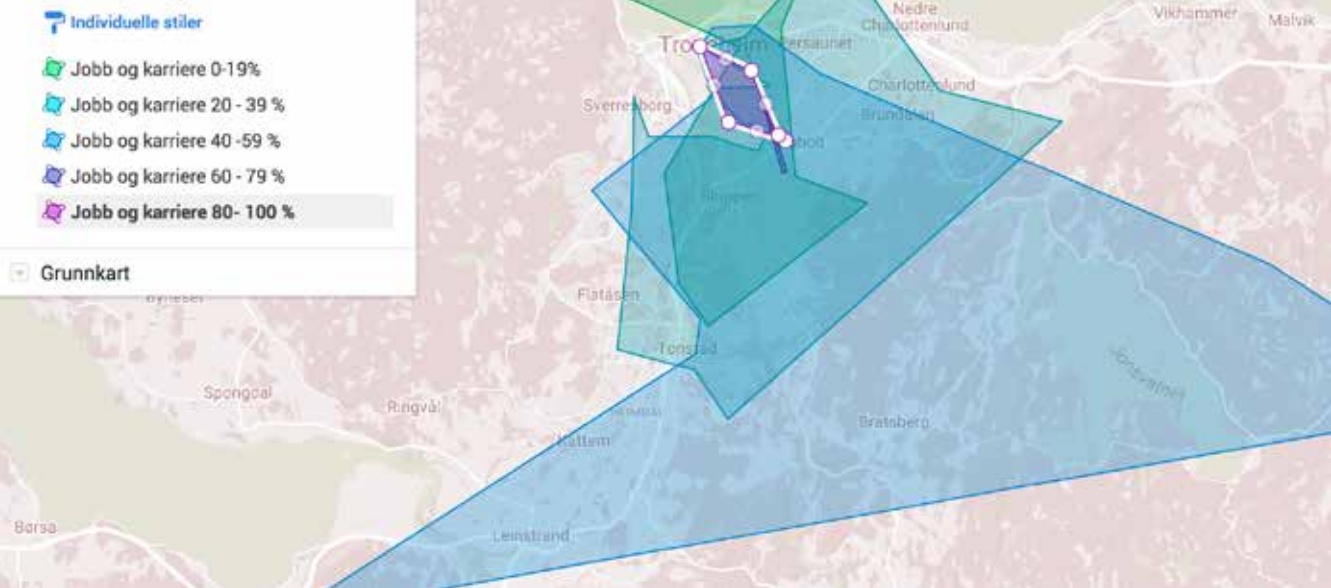
With 49 data points from people living in Trondheim, I started exploring ways of making the data come alive. How could you use geographical locations to add value to personal sentiments? How could you combine the data, highlight individuality within the citizen city or showcase it in a way that made it useful to facilitate good decision making?



Early exploration of citizen's narrative within an interactive map

Here the 49 data points from the questionnaire is put into their 'home address', the postcode they gave as home. The different colours are postcode measured after city proximity, and the lines are daily commuting routes with their quantified experience of living in Trondheim. What I wanted to explore was; how to pin point personal narratives and creating storylines within a geographical area? Drawing qualitative histories from quantitative data, and using percentage to validate the accuracy of personal sentiments? could this be useful information for a city manager?



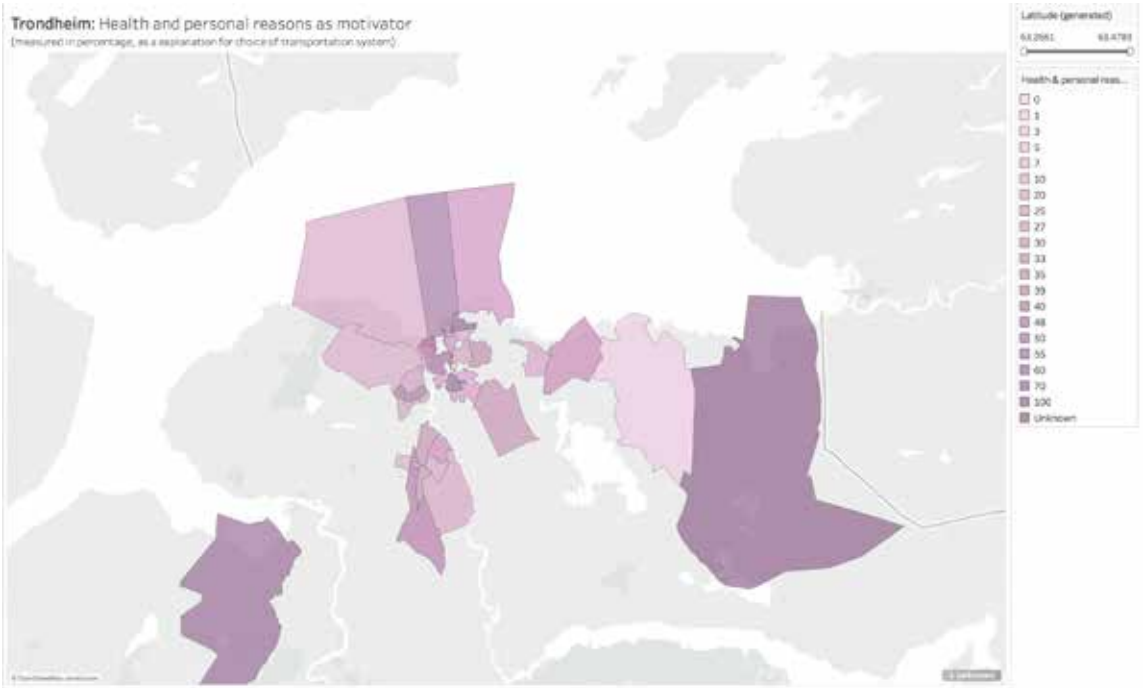


Trondheim by career ambition

I also worked with mapping the outstretch of a percentage. In this case, I classified all the answers after how much they prioritized living in Trondheim because of work & career. Although 49 data points is not a big enough sample to conclude on, in this mapping it showed that they who prioritized career the most (60-79%, and 80-100 %) for choosing to live in Trondheim, where living in a little area in the city centre. Interestingly enough, the third group who lived in the most concentrated proximity to the city centre, were the ones giving work the lowest reason (0-19%) for choosing to live in Trondheim.

This information could say something about 'the personality of downtown Trondheim' or it might relate to completely other factors. However, it confirmed the idea I had picked up from civic tech that using geography to outline a situation adds an extra information layer. With a big enough sample, you could start to deduct something about citizen's city by geographical areas.

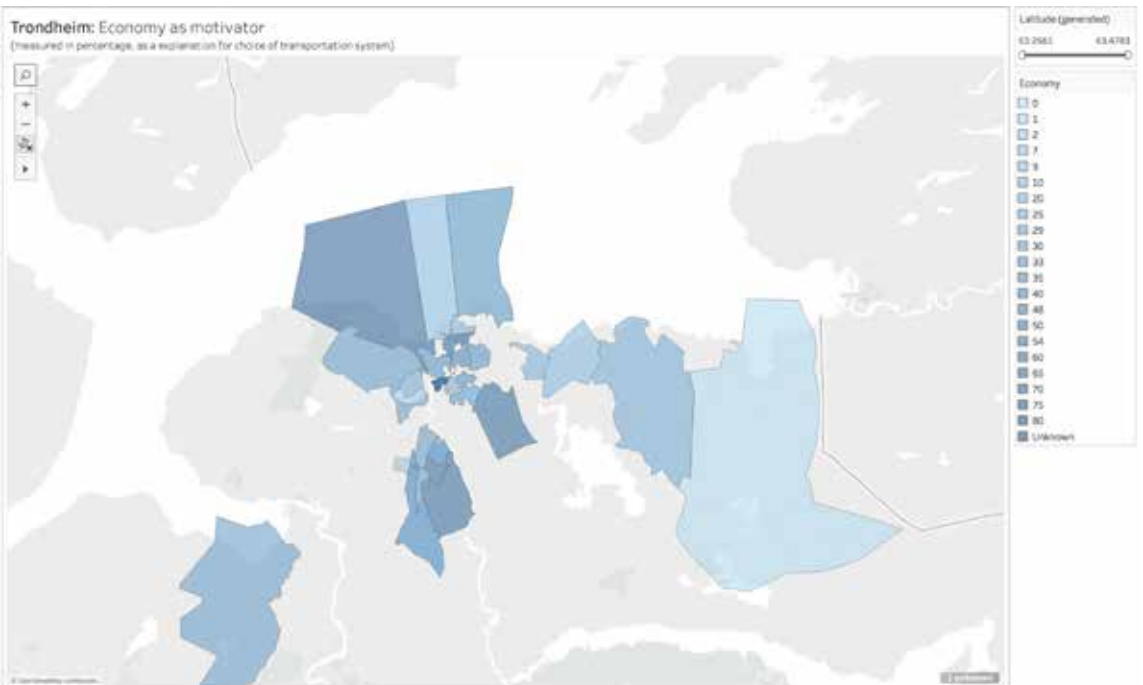


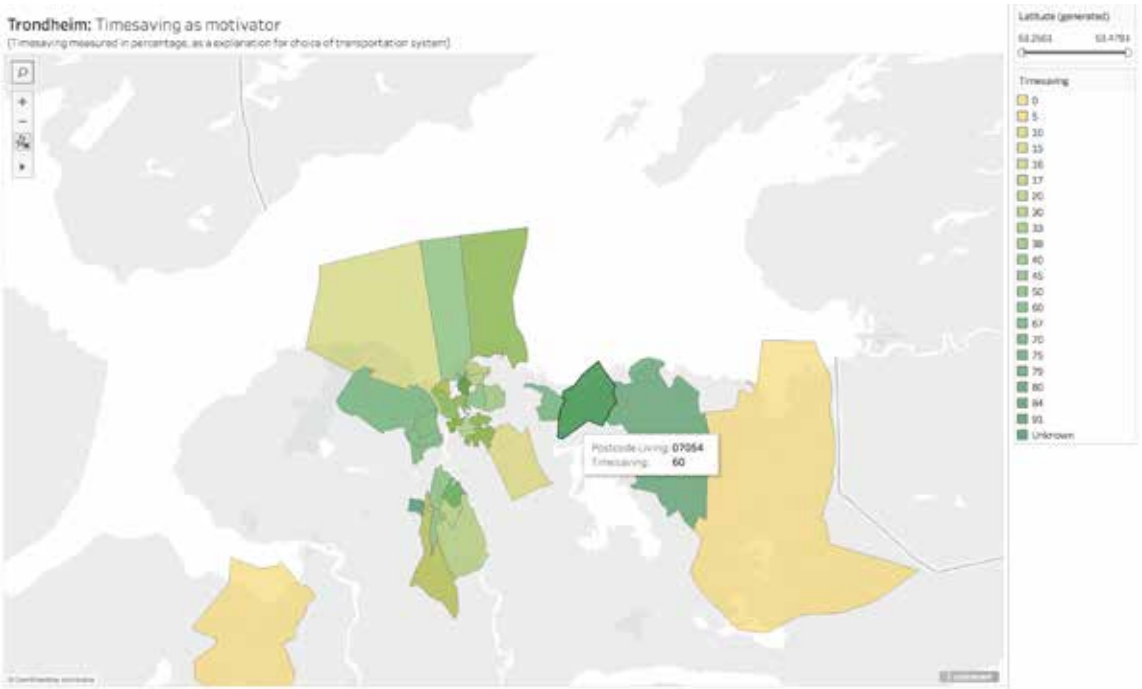


Testing how to make the data come alive

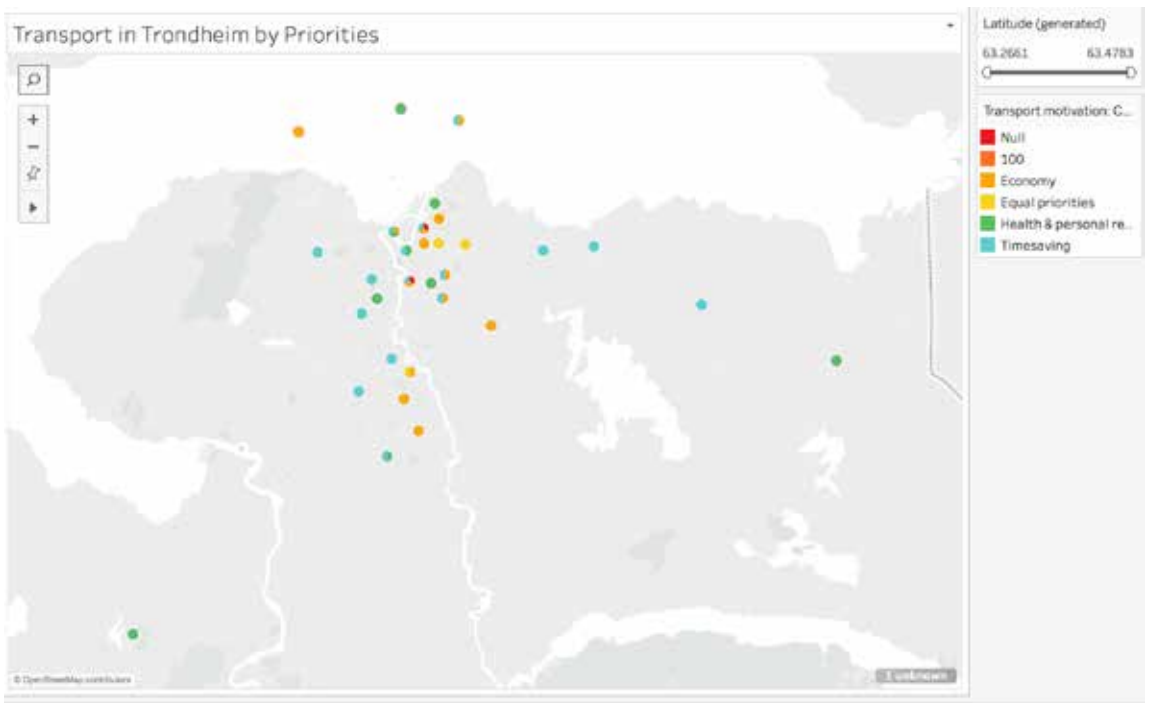
Geographical concentration of personal motivation for choosing transport mode.

Intensity of colour increases with percentage. Purple is 'Health, flexibility and other personal reasons', blue is 'economy and price', green is 'timesaving'





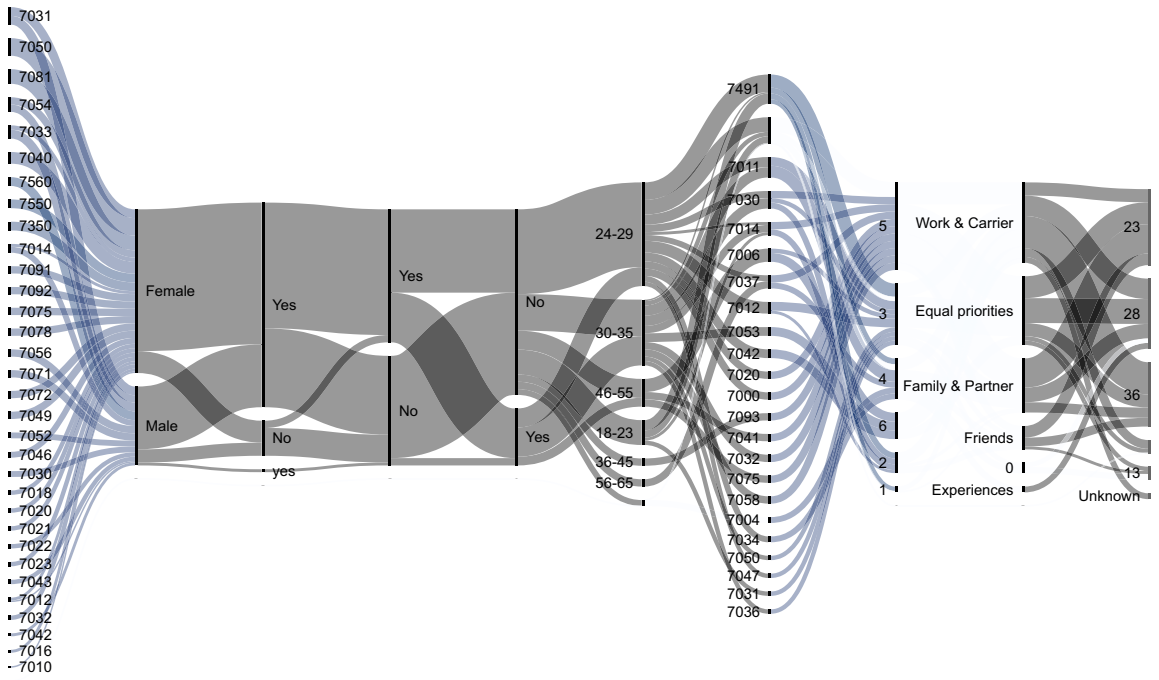
The last one is a map of all motivation in a pie chart, with each pie chart representing one answer. such a geographical overview of people's feelings for choice of transport could be useful for urban planning offices and smart city incentives on public transport systems. The display is made with the free software Tableau, that base it is maps on OpenStreetMap, an open data initiative.



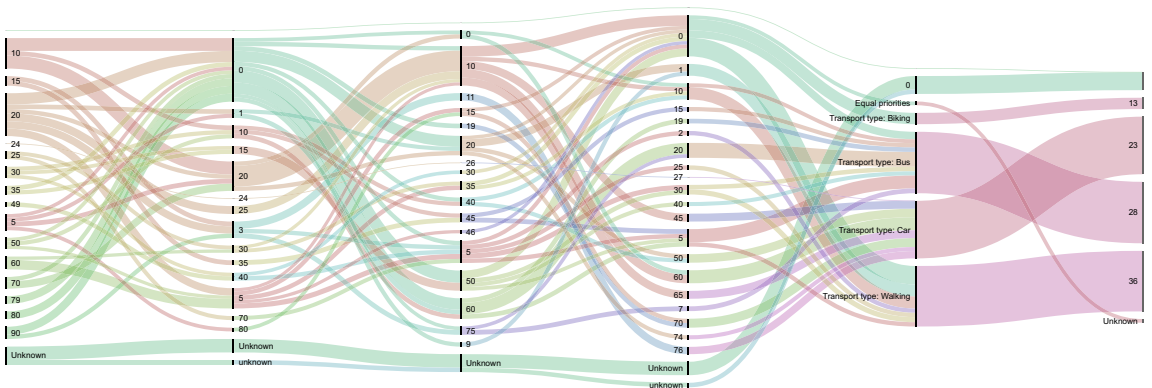
Testing how to make the data come alive

Looking at the data in long, linear lines gave an interesting perspective of people's priorities. Suddenly one could see potential connections that would be difficult to spot from a matrix or spreadsheet display of the same data.

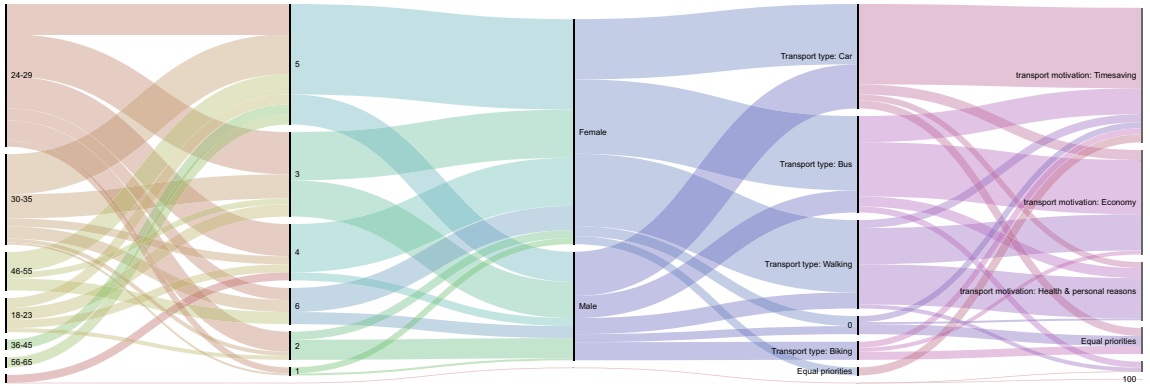
The graphs are built on the free open source visualization framework RAW, which has the goal of making visual representation of complex data easy for everyone.



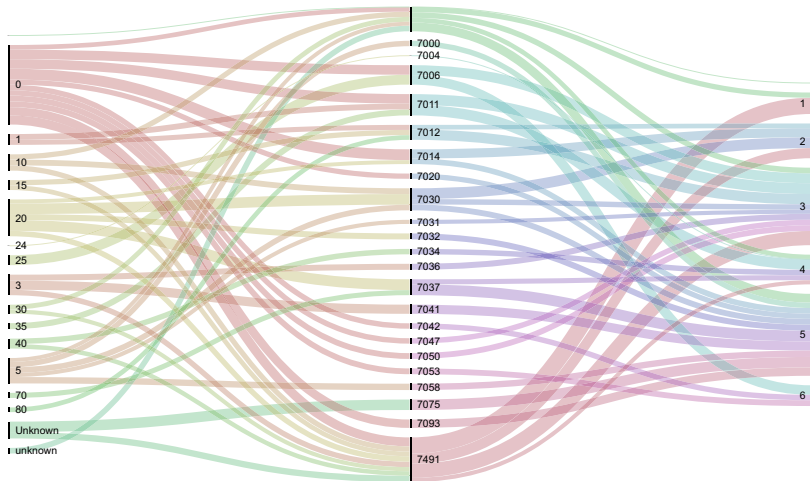
postcode home, gender, working, have car? kids? age group, postcode work, city proximity, reasons for choosing Trondheim, motivation average



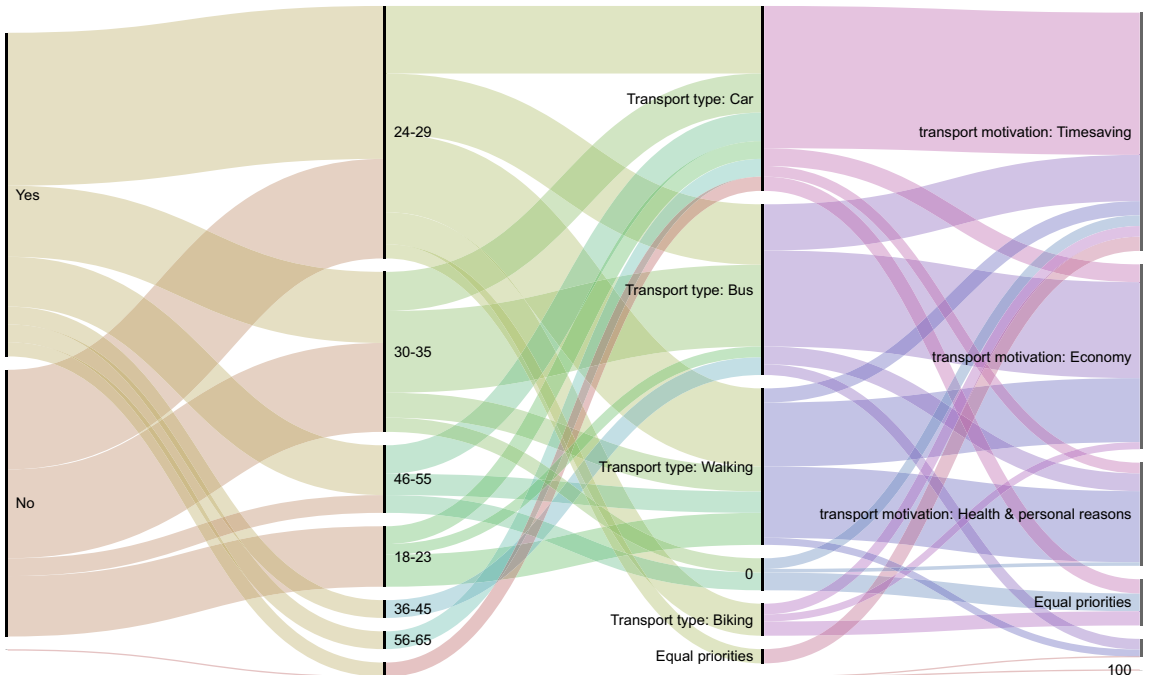
Walk %, Bike %, Public transit %, Car %, Transport, Transport average



Age group, City proximity, Gender, Transport, Transport motivation



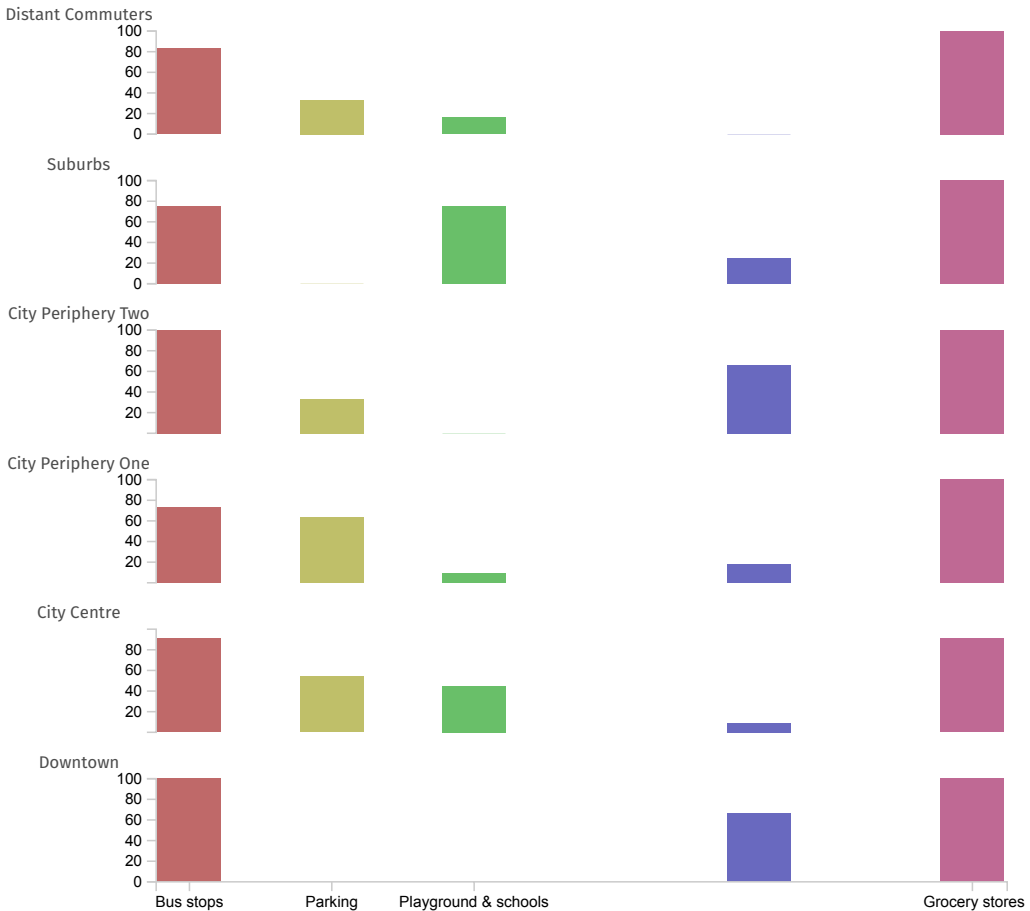
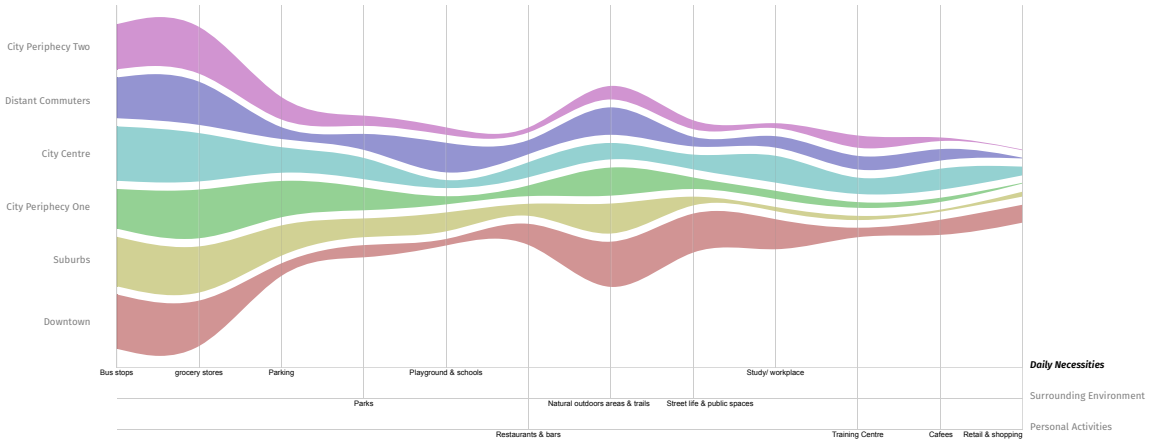
Bike %, Postcode travel to, City proximity



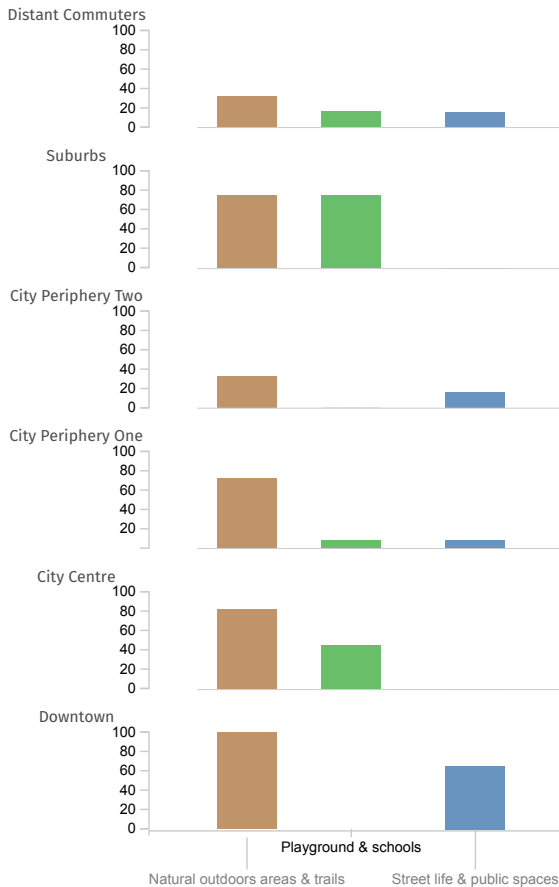
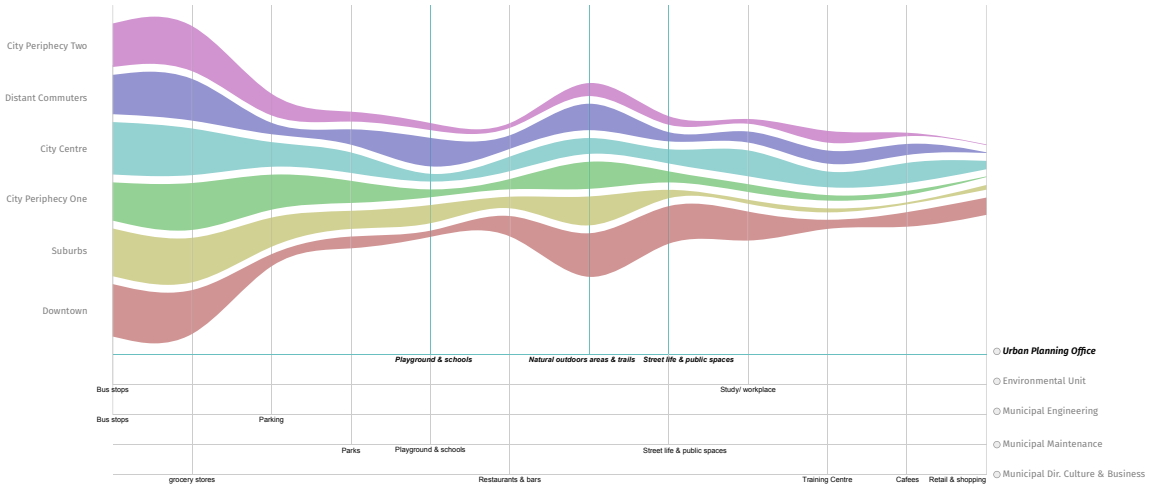
Have Car, Age group, Transport, Transport motivation

Testing how to make the data come alive

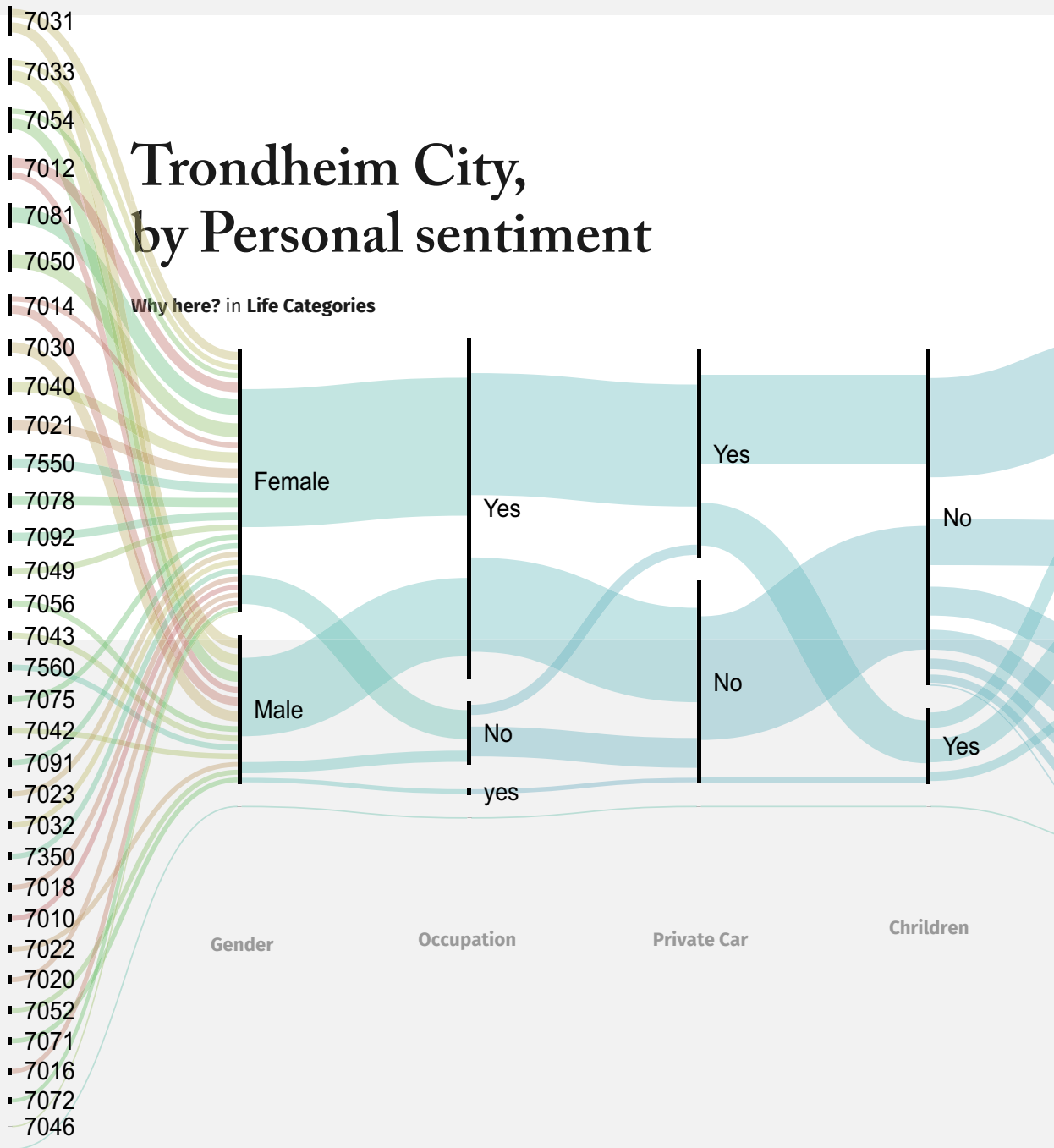
I also looked at structuring the information to different groups. Beneath is the ranking of facilities close to home from the questionnaire, here categorized after citizens 'daily necessities', 'surrounding environment' and 'personal activities'.



Here the same information is displayed after responsibilities for city service domains. This could be an interesting way of bridging the way citizens prioritize what's important to them in daily life, and seeing how that reflect to how city operational groups are organized.

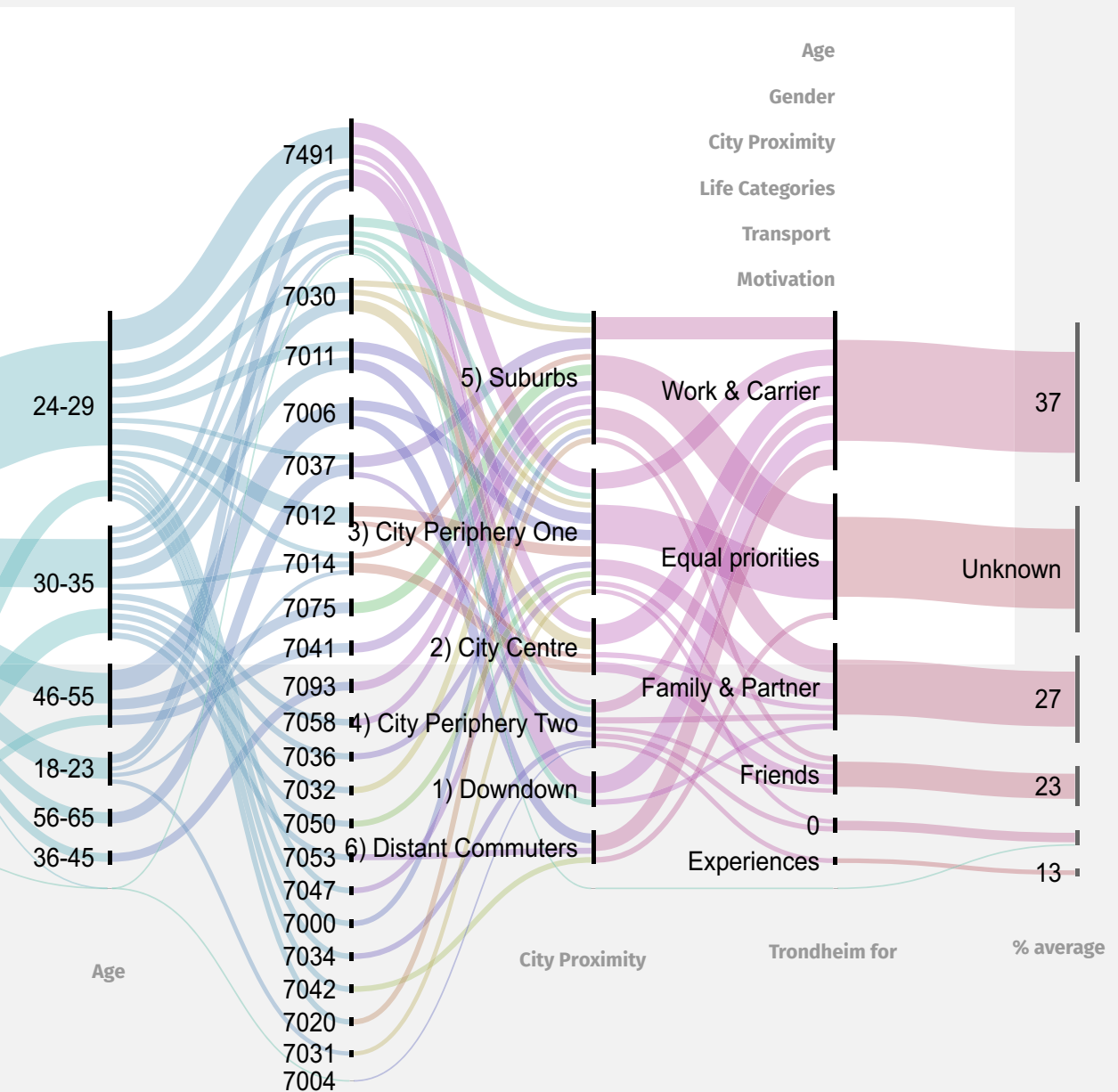


Trondheim City, by Personal sentiment



Testing how to make the data come alive

I did many variations, and tried to give a complete picture of the survey in a more formal version. The idea behind this graph was to both show the citizen's lives flowing across in individual forking's, but also the larger, most prominent currents of the city.



This visualization and the others was based on a survey with only 49 answers, but did indicate that with a bigger sample one could quite easily extract information from a 2-minute survey about citizen's priorities that could be useful for smart city initiatives and smart city managers. I had started the questionnaire to test the triangle method as an easy and quick way to extract useful data about citizens, and felt the concept feasibility was tested and sound. I then finalized into the final concept.

Chapter Five

*Final
Concept*

Introduction to chapter

In this chapter, the final concept will be explained. The concept explanation is structured in three parts.

- First comes a general outline of the service concept, that go through the stakeholders involved in the process and what they gain from the service. The actors involved are normal citizens, Powel and Smart City Managers.
- Secondly, story telling is used to communicate the purpose and benefits of the new service offering from the citizen perspective and the the Smart City Managers perspective.

Outlining of the concept.

The concept is founded on the insight that urban decision makers is in need of more specified, in-depth knowledge about their citizens. This is both a political goal and a need that was reoccurring in the workshops.

Powel as a company is interested in exploring where they can position themselves as a Smart city supplier. They have extensive knowledge within many sectors that is key operational units of smart city services like water, electricity and fibre. From the research conducted, it is concluded that although operational units are very important and could benefit from smoother, more efficient systems, however the big challenge and much of the focus for smart city today is at a strategic level dealing with the transition towards a more citizen centred run of the public services.

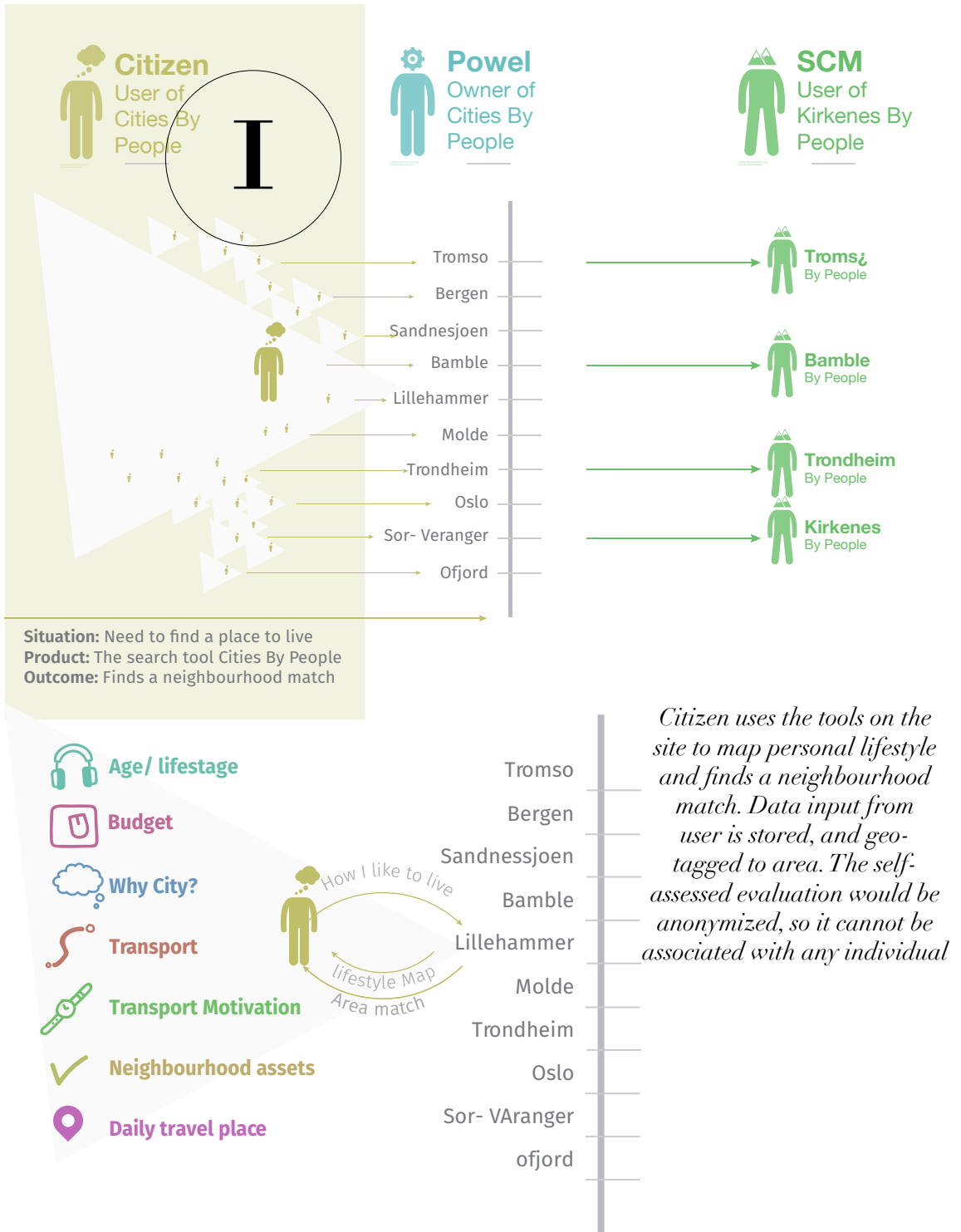
In this new business climate, that is disruptive to many of the old structures, this service concept is a proposal to how Powel could position themselves in a sphere of old and new companies looking to be smart city service providers.

The benefit would be to be an early adapter and enabler of indirect citizen co-creating in public sector.

The service concept is broad, with many potential areas of application. Therefore, to give the concept enough context when explaining it, the suggested area of application is for citizen's looking for a new place to live. Visualizations of the general outline is on the next three pages.

Cities By People is a platform and search engine built on open data.

The platform is hosted and operated by Powel, and have two interfaces; one aimed at the public and one aimed at a SCM or others with similar tasks. The interface used by citizen's is free, and the interface for a SCM is paid for.




Outlining of the concept

Citizen
User of
Cities By
People



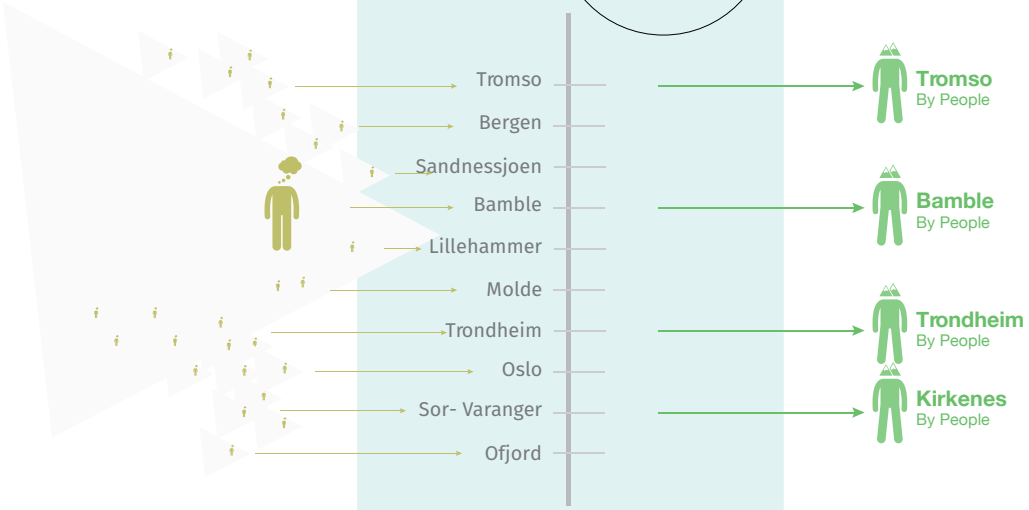
Powel
Owner of
Cities By
People



SCM
User of
Kirkenes By
People



2




Situation: Have city-specific data of what citizens want
Product: Sells the analytic tool *City* By People
Outcome: A Smart city business model

Citizen
User of
Cities By
People



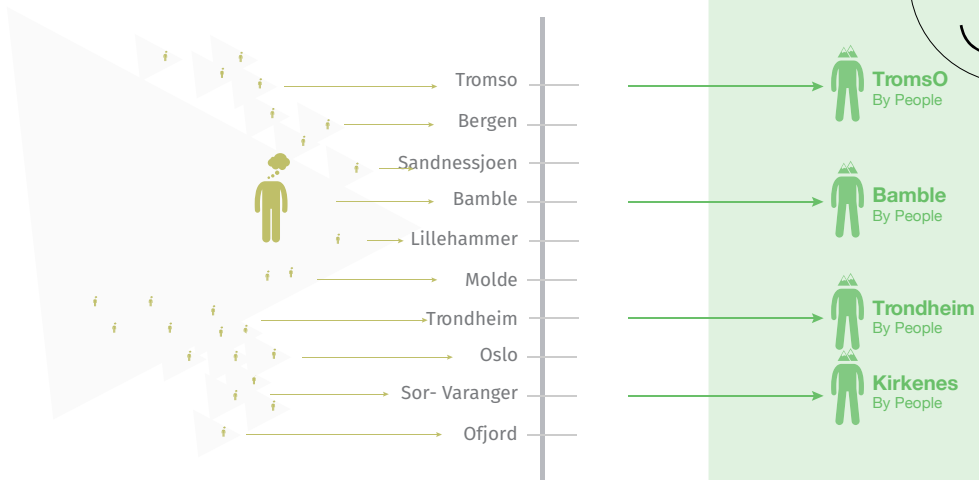
Powel
Owner of
Cities By
People



SCM
User of
Kirkenes By
People



3



Situation: Need to understand their citizens
Product: The analytic tool *MyCity* By People
Outcome: Uses it for measuring and planning SC initiatives



Citizen
User of
Cities By
People

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Powel builds and operate the platform 'Cities By People'. Although they have the cost of building it, the background data the platform is based upon is open and free. It is also necessary with just one base code. If the market was

Norway for example, Powel could build one platform, that would be the same for all the citizens looking to settle down all over the country. The citizens would be directed to their desired city automatically: The benefits of the solution are that Powel has accesses to city-



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Powel
Owner of
Cities By
People

User input:	Used in defining neighborhood match in Cities for People
 Age/ lifestage	
 Budget	✓
 Why City?	
 Transport	✓
 Transport Motivation	
 Neighbourhood assets	✓
 Daily travel place	✓

How the data is used:

The data provided by the citizen is used both to find a neighbourhood match for him directly,

Outlining of the concept

specific information from the citizens about their priorities. This is useful in building new application like the SCM interface, but consumer insight could also be used in meeting with other business partner like water and energy providers looking to understand the smart city market.



SCM
User of
Kirkenes By
People

Neighborhood
people

Used in analytic tool Kirkenes By
People for visualizing citizen opinion



and to build the analytic platform of the Smart City Manager.



Citizen

User of
Cities By
People

Created by Gauri Puri for
Open the World Project



Power

Owner of
Cities By
People

Created by Gauri Puri for
Open the World Project



Cities
By People



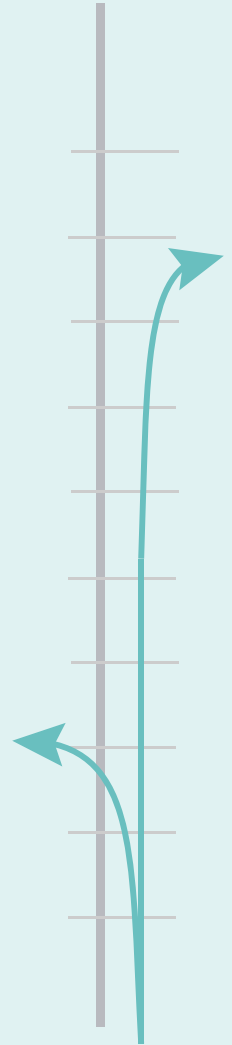
Cities
By People



Data Type:
Self assessed
citizen data



Data Type:
Open data



Data type:
Open data





Created by Glen Kloum for
Open the House Project

SCM

User of
Kirkenes By
People

Outlining of the concept



MyCity
By People

Data Type:
Self assessed citizen
data & Open data

Data Type:
Open data &
municipal data



MyCity
By People

Types of data, and data flow.



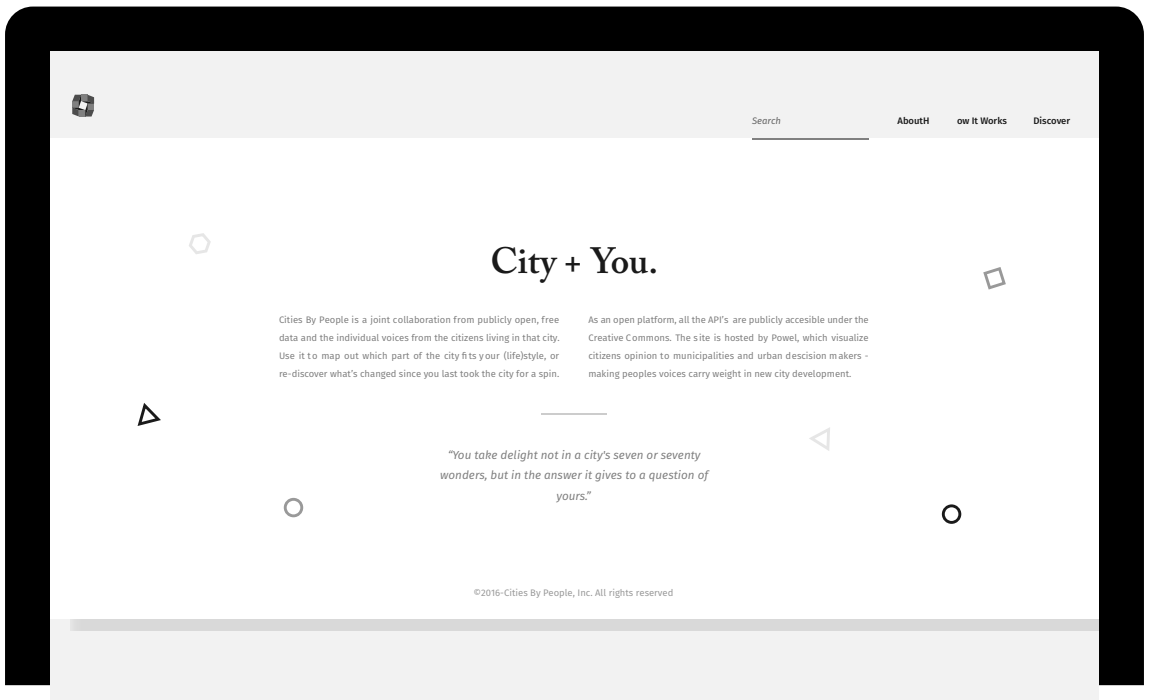
Storytelling

Story telling is used to communicate the purpose and benefits of the new service offering from the citizen perspective. Pages where the background is market in gray, has explanation and clarification of selected points. Text and interface is not defined, but suggested. The main purpose is to explain the flow of the system, and the intended information from each step

This story follows the two end-user Even - who is in the process of finding a new place to stay in Trondheim - and Marit, the SCM of Trondheim.

Introduction:

Even is a 19-year-old from Bergen. He lives with his parents, but is really looking forward to starting a new student life in Trondheim. He finished high school before summer, and just got the admission letter a couple of days ago. Keen to plan for a new life, and excited about all the things he plan to experience he is now sitting in front of his laptop to search for a place to live.



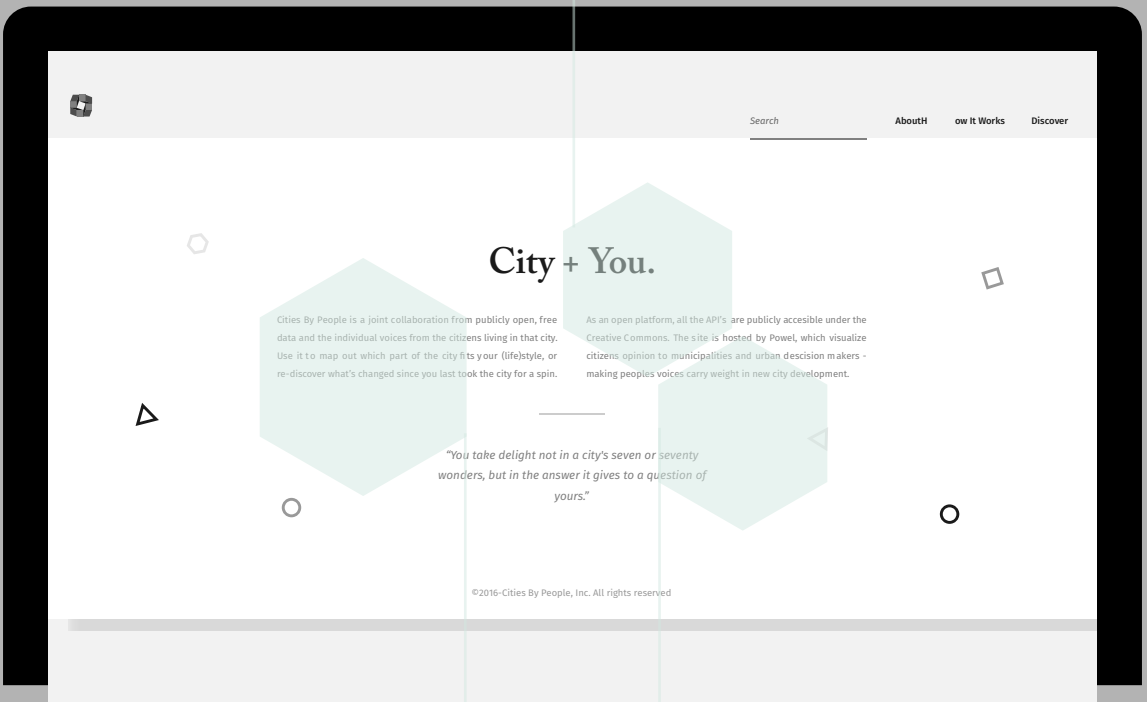
Even starts by typing in 'Trondheim flat for rent' in google search. One of the first thing that comes up in the search list is a page called 'Cities By People'. He clicks on it and is directed to a landing page.

He quickly glances through the text, sub-consciously think it looks all right and follow the instruction to start mapping your lifestyle. He is curious to find out more about Trondheim.

Open API, publicly accessible

'As an open platform, the API is publicly accessible under the creative commons'.

Ensuring the user that this is a safe site to leave your data is important. Even if one just quickly register it, open data is becoming more normal and expected, and can inspire confidence in users otherwise reluctant to share information.



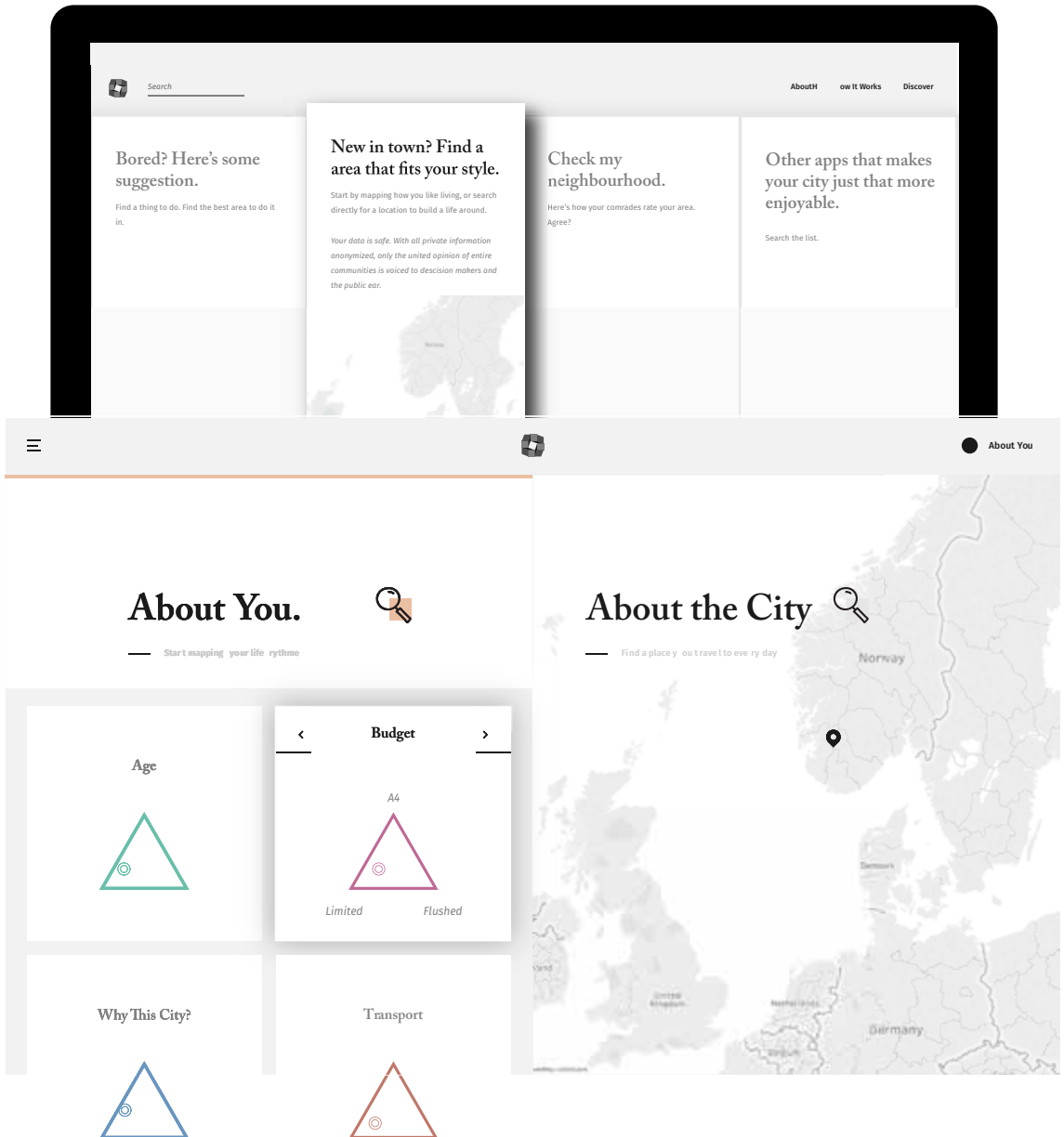
What's in it for you: 'Map out which part of the city fits your (life)style'

The most important thing is to quick and easy explain how the user can benefit from the page directly.

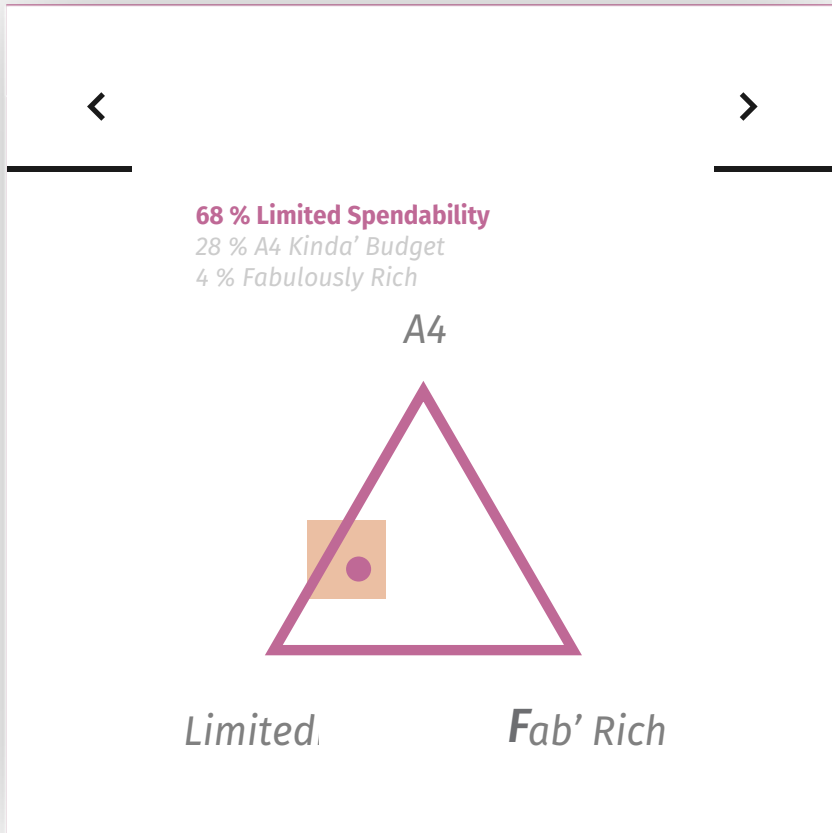
Site hosted by Powel

'This site is hosted by Powel, which visualize citizen's opinions to municipalities and urban decision maker - making people voices carry weight in new city development'.

Being upfront about participation and business structures is important, even when it is for the public good

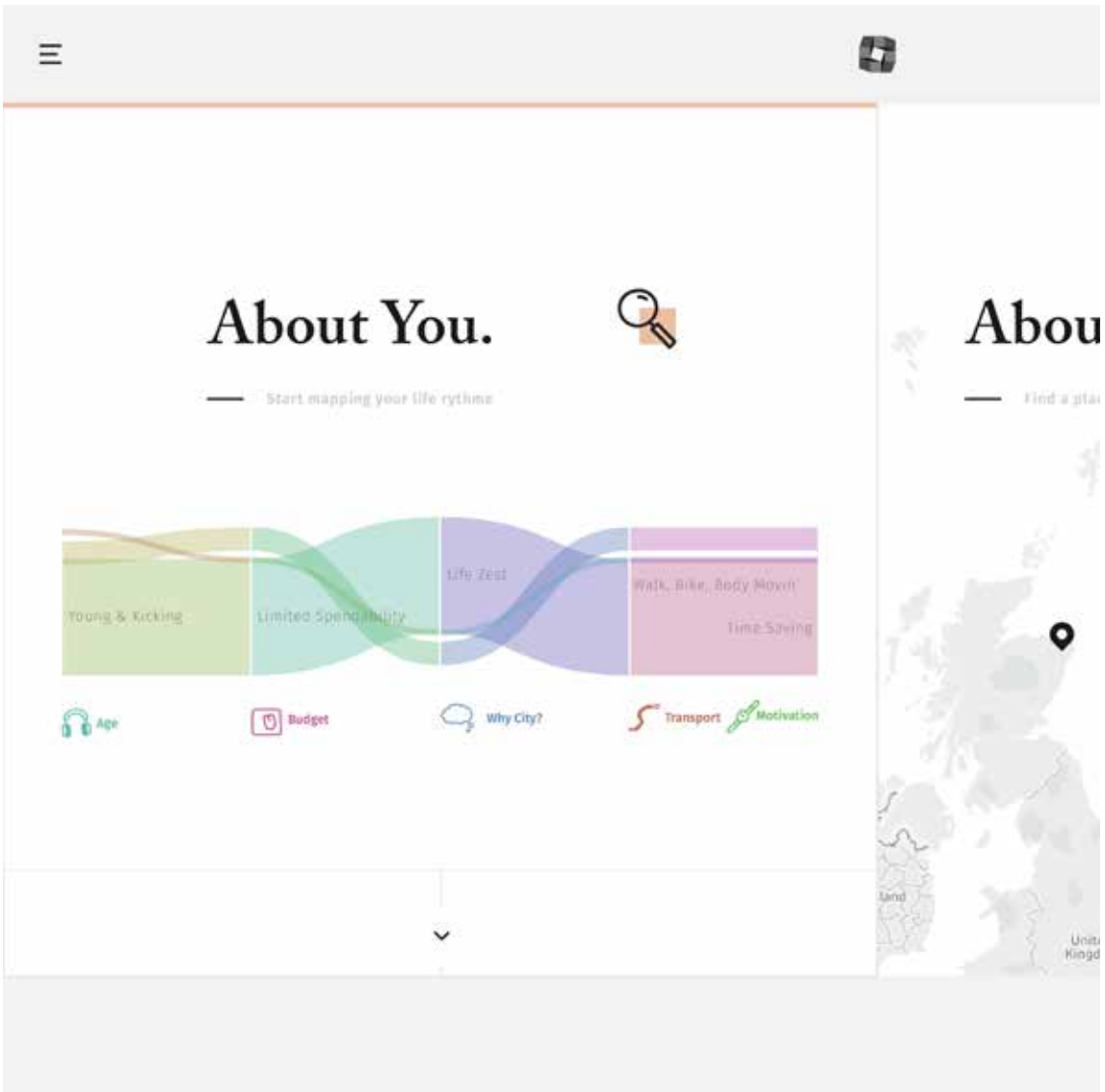


A text about data privacy shows up, and Evan jumps one step further. On the next page, he sees he has the choice of either starting with exploring Trondheim in a map, or 'mapping himself' as it is written. That side asks him to fill in some triangles as a way of figuring out what Evan wants from living in Trondheim. He finds this a bit amusing as he has not seen it before, but he quickly gets the gist of it and has positioned the circle in all the topics within few minutes.



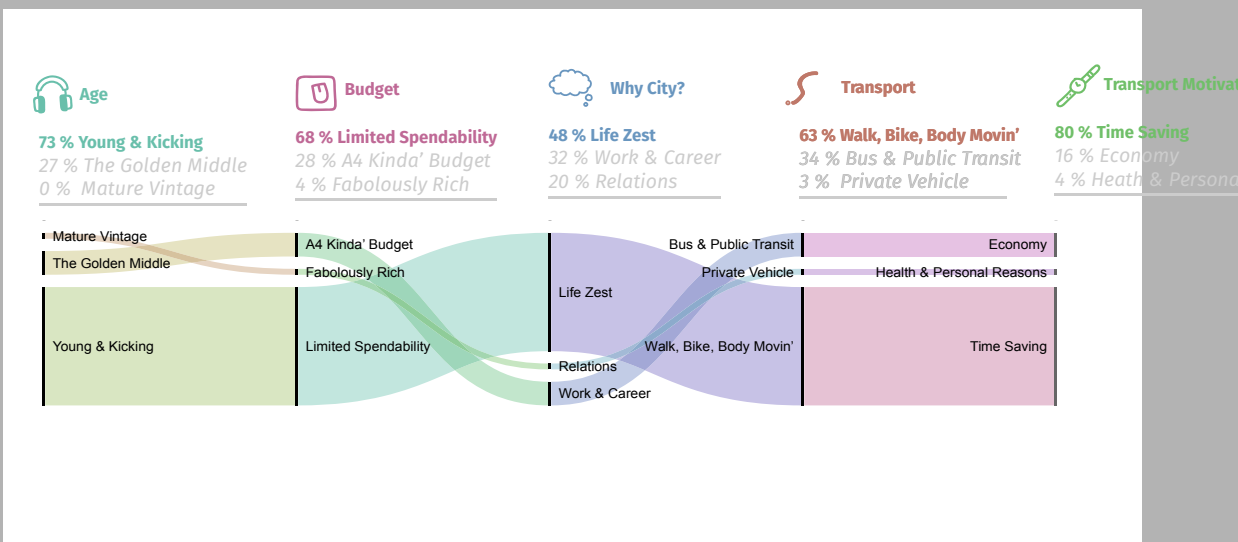
Quantifying the user input:

The triangle self-assessment method is always within 100 % and therefore measurable



When finishing the last triangle, Even gets intrigued. A 'life graph' of his choices shows up, and it is interesting to take a look at himself from this point of view. He has always liked personality tests, and this kind of reminds him of that. He can zoom into the graph to see the details, which he does for a little while - but then he notices there are a couple of other self-mapping options too, so he continues with that. Within a few minutes Even has mapped what he wants to get from Trondheim, and he can now start looking at how Trondheim matches him.

Citizen storytelling



Quantifying the user input:

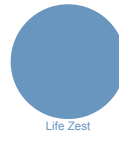
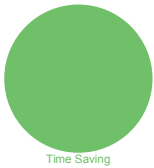
One does not have to frame the questions according to traditional filters. For instance, it might be more interesting for city managers to see where people position themselves in terms of stability and settling down, then their concrete age. Instead of deducting for the citizens by some average measurements (man, 32 years old, probably in the stage of starting a family) one can learn how people actually classify themselves. To put it on the edge; if 60 % of the people in the municipality normally classified as seniors deem themselves as young at heart and full of life zest, then it could be worth knowing.

How one form the questions depend on what the indented learning outcome it, and could be done in many ways. The main point is this is a way of quantifying citizens self-experienced feeling of their life stage and priorities.

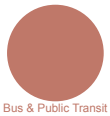
About You.



— Here's what you mapped so far!



On most days...
Check the area who fits the profile!

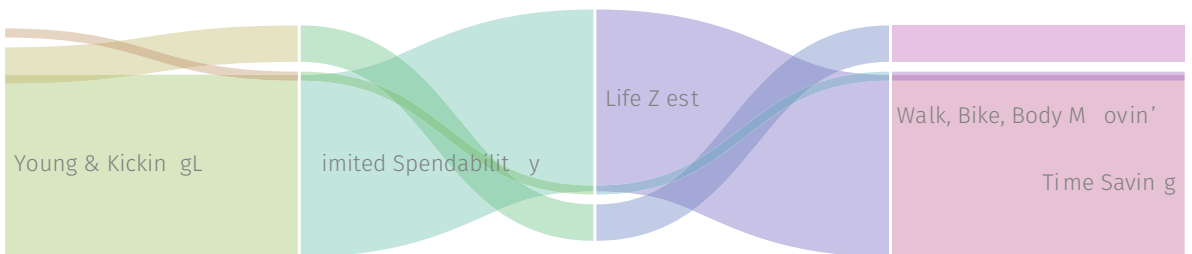


Sometimes..
Maybe where you would like to live in the future?



Mature Vintage

Once in a blue moon..
we got some neighbourhood suggestion if you would like ..



It is been mostly fun, but Even feels he has a bit better notion about what's important for him when finding a place to live in Trondheim now. He follows the recommendation for 'On most days...' which switches the mode so he is now exploring Trondheim from the map side.

From the map, the first thing the site asks about, is if Even has a daily commute for example to a work- or study place? Even type in the university name, and the map

Type a place you travel to every day ...



Citizen storytelling

About the City

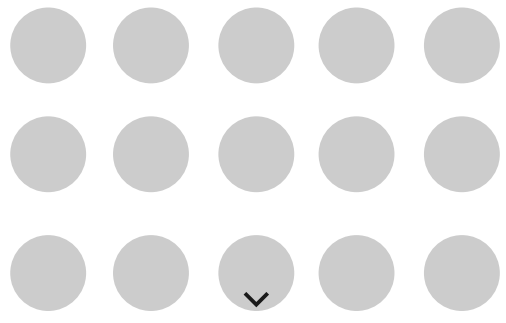


Start Mapping the City



< Neighbourhood >

Click on the facilities you prioritise having within 15 min walking distance



Walkability Score

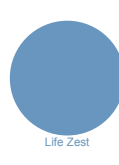
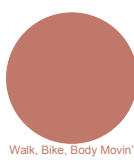
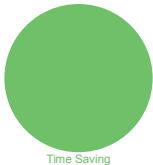
Transport

generates a couple of areas that fit his current profile. He can modify neighbourhood specifics like proximity to grocery store. Since he continues working for the same store chain as in Bergen, he needs to be close to the city center. There are other filter systems too, but the site has generated 3 matchin areas. Even is content with that. He reads about them before using the built-in feature to check housing prices and apartments for rent and settles for a trade-off between proximity to nature and work.

About

Triangle self-assessment method

Here's what you mapped so far



On most days...
Check the area who fits the profile!

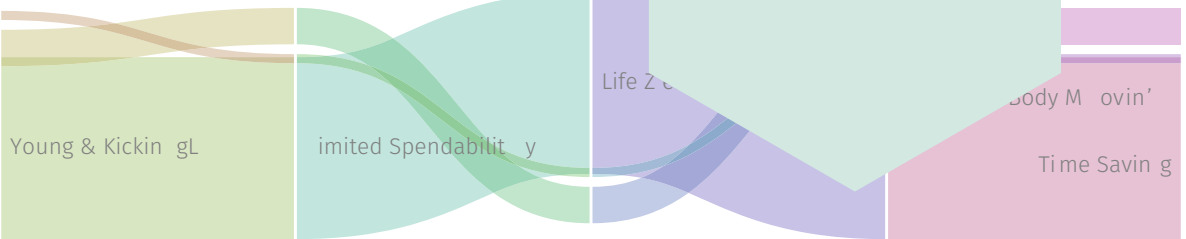


Sometimes..
Maybe where you would like to live in the future?



On moon...
Neighbourhood you would like ..

Lifestyle Map



Type a place you travel to every day ...

Citizen storytelling

About

GPS location and daily travel destination



Norway

Start Mapping

< Neighbourhood >

Click facilities you prioritise
here within walking distance

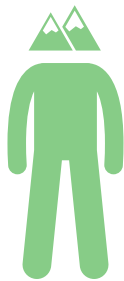
Required
Neighbourhood
facilities



Feature for
transport options

Walkability Score

As an early concept, the features for deducting citizen's priorities and matching with city area would need to be defined properly. The features mentioned above are some suggestions.



Smart City Manager:

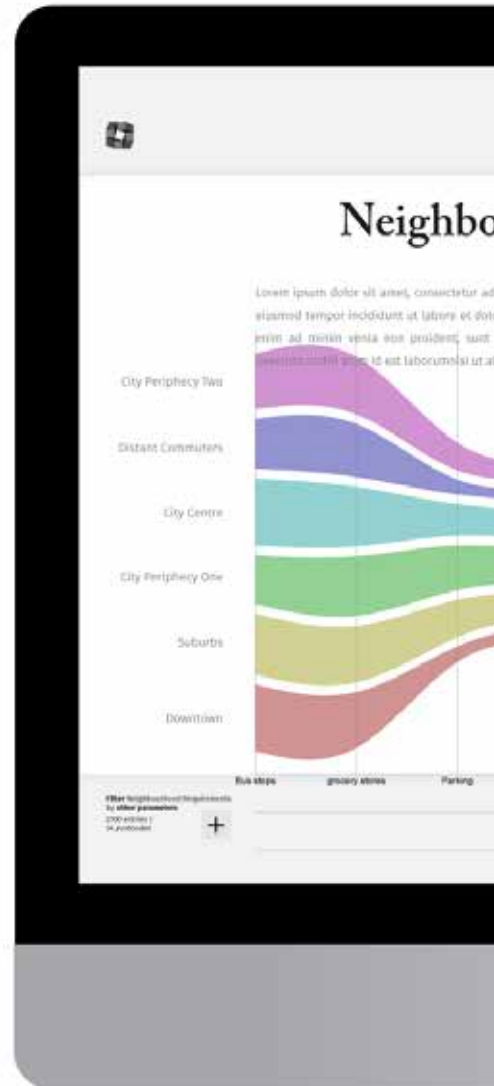
The one data-point that Even created is now integrated in the data base located on Powel's secure servers. This growing data-set allows the SCM to browse not only through the motivations of the citizens, but also the trade-offs they made when choosing their place to stay. This allows the city to pinpoint shortcomings in real time and subsequently fixing them by e.g. adding a bus route that brings certain areas closer to nature.

Furthermore, the SCM can track changes in the development of certain areas and how the population changes motivation and priorities over time. This allows for getting a feedback on previous actions (e.g. bus route) and see if the goals were achieved, thus allowing for prototyping the 'perfect' neighbourhood. Furthermore, future urban planning can rely on these insights in order to create city areas according to the citizens needs.

150 Smart City Manager:

Marit is the SCM in Trondheim and therefore has access to Trondheim by People to analyse the anonymous data - amongst others from Even. She has a meeting the next day regarding the development of a new area in the outskirts of the city. In order to build an argument for what the citizens want from this new area, she looks at what people in similar surroundings prioritize to have within 15 minutes of walking distance to their home - the current Neighbourhood Requirements of the citizens. Even had to chose proximity to work.

In a smiliar fashion, she can see what citizens are lacking within certain areas and how this could be adressed in the new development area - for example Even is missing out on nature.



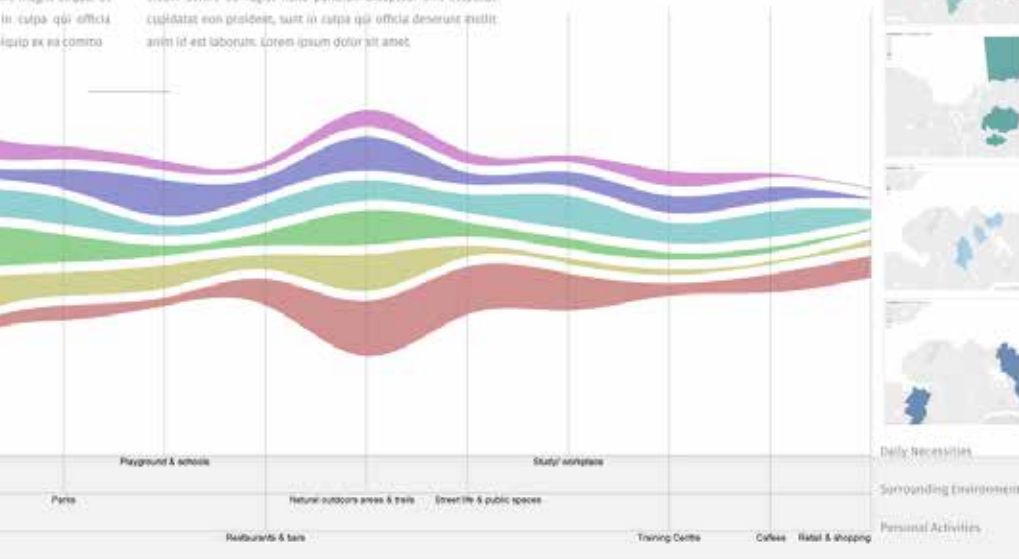
Search

Discover Explore

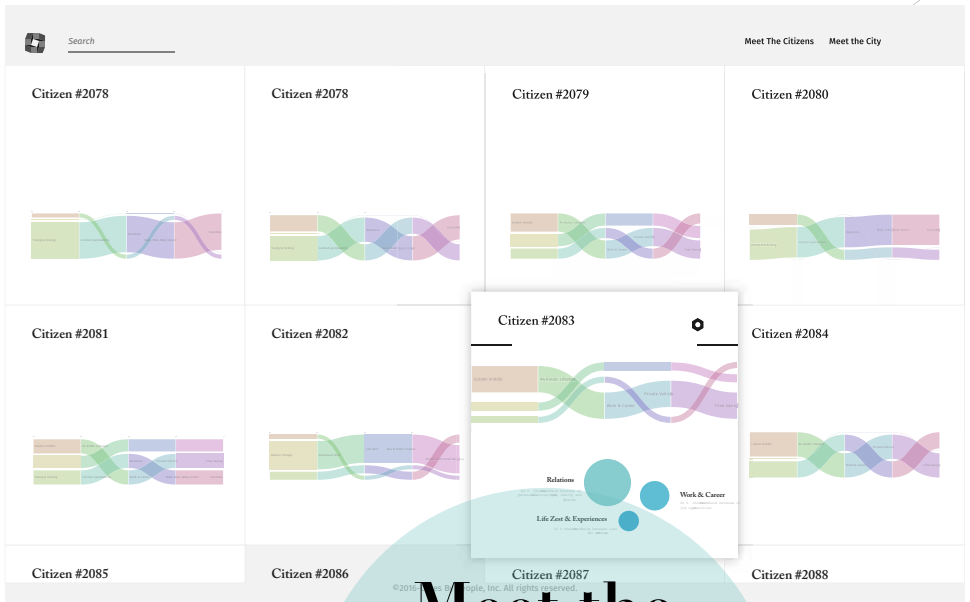
Neighborhood Requirements

ipiscing elit, sed do
e magna aliqua. Ut
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Duis aute irure dolor in reprehenderit in voluptate velit esse
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anim id est laborum. Lorem ipsum dolor sit amet



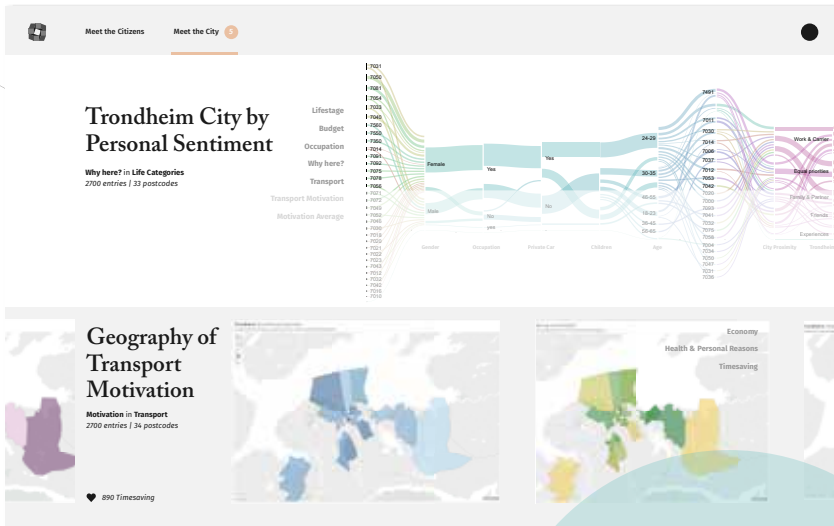
Daily necessities
Surrounding Environment
Personal Activities



Meet the Citizens

City Library of Human
lives

Marit also looks at some random individual citizens within the area of interest. Every now and then she finds interesting insights that are contradictory to her personal opinion and experience - which is important, since the city is for everyone.



Meet the City

Geographical

Furthermore, she remembers another development area a few years past that had a similar starting ground. She has a look at the map of that area and is pleased to see that many of the original citizens are still living there, confirming that the area was built towards these target users.

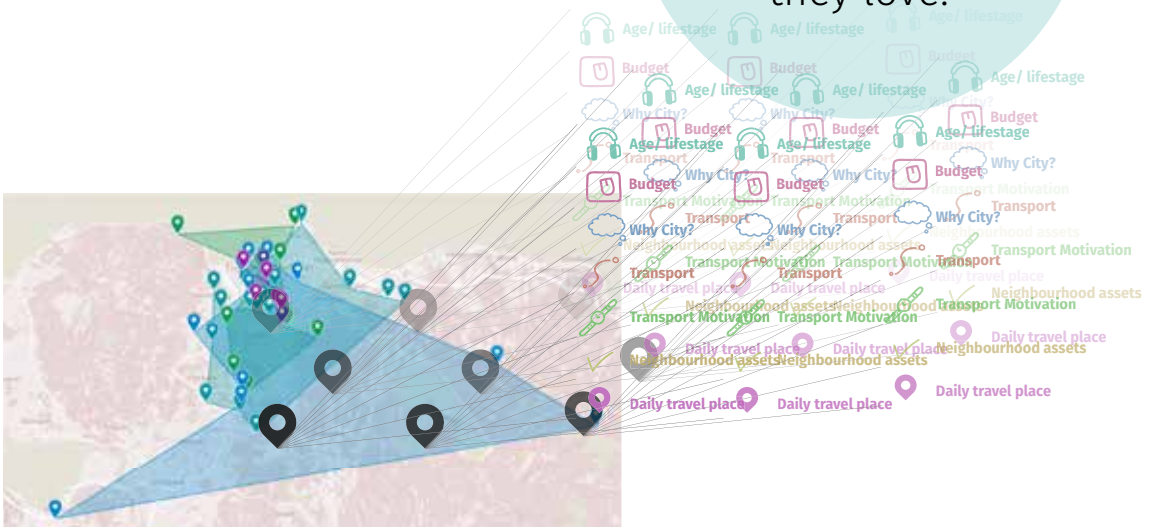
154 Plan the city with the citizens and for the citizens:

At the meeting, Marit starts off by presenting the importance of user centred design. She then highlights some of her insights as well as an overview of the relevant data. Especially in combination with a map-overlay of currently existing bike paths and the density of pictures on Flickr taken in that area, it makes a powerful statement for what **exactly** the citizens want and what they like today about the area.

The premium realises that some of the ideas and plans they had for the neighbourhood could have been an expensive mistake, while other, overlooked features turn out to be essential. For example, what they thought to be simply an old piece of railroad track turned out to be a popular meeting spot for young families - apparently the kids love playing trains!

Discover

See where people want to be and what they love.





Explore and Plan

Mix Data

Trondheim by People:

The platform is much more than just a pool of data. It is a powerful tool for growing cities so they can become more efficient, and more attractive to the very heart of the every city - the people.

Chapter Six

*Final
Thoughts*

As described in this thesis, the term Smart City is much more than just one concept. It is a vast network of stakeholders with a large variety of interests. Throughout this master thesis I made use of many methods, and used the insights to develop a product concept: City By People.

Methods:

The workshops and interviews in the earlier phases of the project were essential and provided a lot of knowledge and deep insights into the smart cities developments around the world. It would have been impossible to gather all of this information without the insights of various helpful people.

However, all of this information, combined with the insights from the desktop research, turned out to be complex to handle. This is where the giga map came into play as a powerful tool to keep a clear overview. While it is not easy to organize all the various levels of insights within a two dimensional map, it provided necessary guiding when exploring the gathered information.

Product:

The key-insight that led to the development of the product concept is the lack of user involvement - specifically the citizens itself - in current smart city processes. Since this insight is based on multiple workshops, it can be considered true. Surely, the few workshops are not of significant number when it comes to statistical evaluations and the insights are limited to Trondheim. However, the high quality of the sources make up for some of these shortcomings.

It is no secret anymore that good products are designed with the user in mind, and there is now proof that this is not the case when cities, specifically Trondheim, are developed.

This background makes a strong argument for the product itself that opens up a business model for Powel: By providing the City By People platform, Powel can become a key-player when it comes to city planning in the future. By being involved from the earliest moment the city grows – when a person decides to move there – and by helping the city to make the right fundamental decisions, Powel can fine tune the rest of their products to match the needs of the growing areas.

Right now, this product is merely a visual concept. The next steps are to implement a test-version of the platform and gather feedback from various stakeholders and users. This will surely bring up some shortcomings and new ideas until someday the platform will help creating cities – by the people.

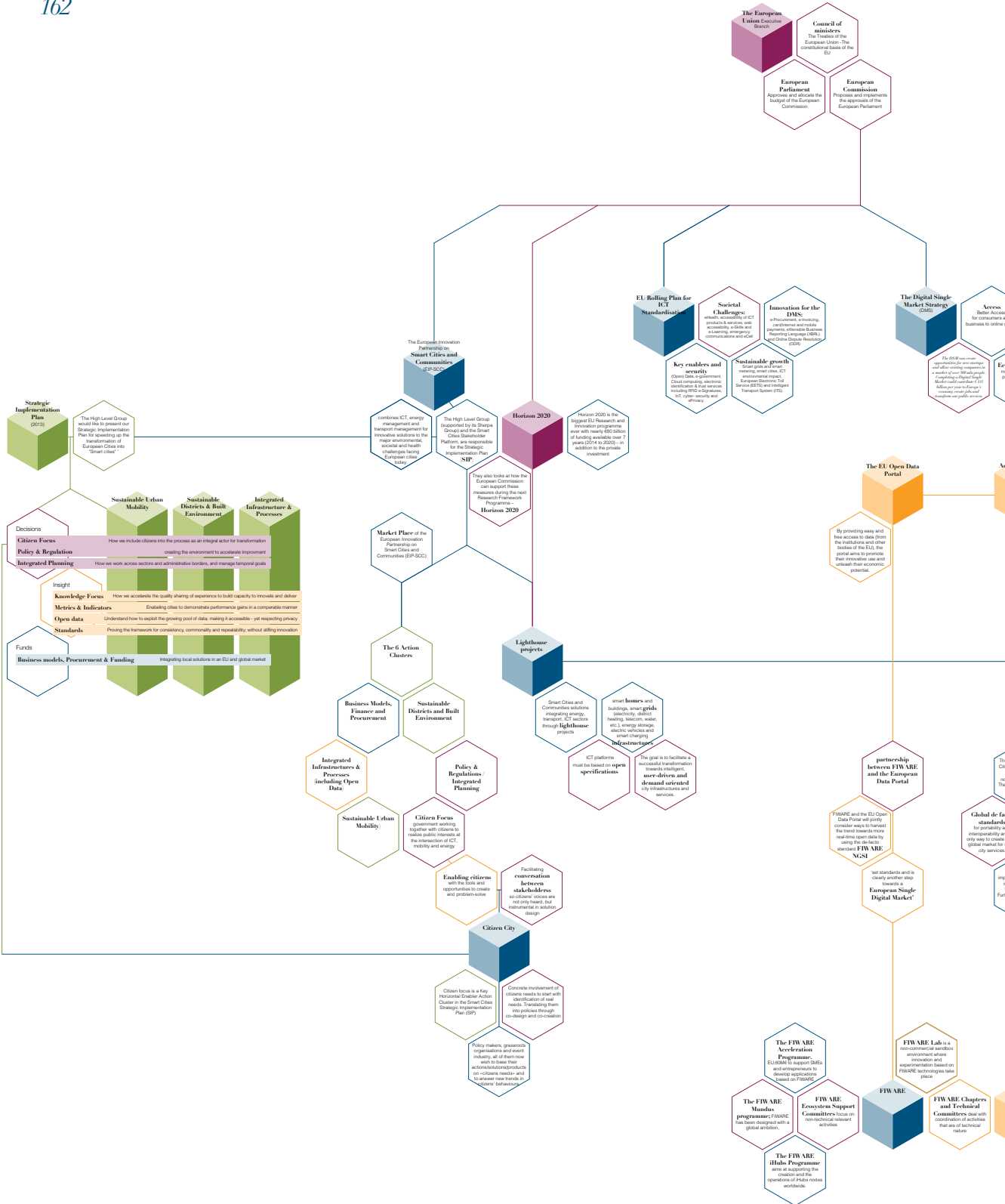
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Appendix

A

Giga-Map



Appendix B

*Decision
journey
Mapping*

The environmental silo has an own climate of decision making and hairy political goals that are difficult to break down into measurable targets. Local, county and national bodies could also block the process afterwards and reject the proposals from the department

City planner
(byplanlegging)
could base
decisions on to
'soft values' and
generic assumptions,
instead of specific
citizen + area insight

Citizens are
slim to not
involved in the
current process

Researchers get
involved when you have
a new 'bump'; undefined
situation that needs solving

Siloed decision
making and
administrative
borders

funding
ENOVA
-> energy-
related targets

NATIONAL
LEVEL POLITICS

"FYLES"
POLITICS

LEGAL
POLITICS

APPROVAL WORK

APPROVAL WORK

The private developer

sector consists of many actors. The process of building can be initiated from both public and private

Outside of the siloed

actors with concrete involvement, you also have other stakeholder with high veto-power but little direct interest. *Vegvesnet* was one example of actors which could block the whole ZEN process due to their own projects

Afterwards?

Who have responsibility of what and runs the ZEN after the building process?

Utility companies sometime consult the

environmental departments on what would be sustainable KPI's and measurables, instead of the other way around. This stem partly from connection back when the utility companies were more integrated in the public sector and partly because the utility companies has a better overview of what is happening in their domain specific sector of the energy business.

*The process of turning into a
Zero- Emission Neighbourhood*

Appendix C

Questionnaire

Postcode Living	Postcode to	Traveling	Kids at home	Got private car	Working/ studying	Gender	Age group	Age	City Proximity	Why here? Career	Why here? Family & Partner	Why here? Friends	Why here? Experiences	Why here? Category Highest Score	Why here? Category average	Trav Wa
7010	7491	No	No	No	Yes	Female	24-29	28	1) Downdown	40	30	20	10	Work & career		37
7012	7491	No	No	No	Yes	Male	30-35	34	1) Downdown	90	0	5	5	Work & career		37
7012		No	No	No	No	Female	24-29	28	1) Downdown	25	35	25	25	Partner		27
7012	7491	No	No	No	Yes	Female	24-29	25	1) Downdown	40	20	30	10	Work & career		37
7014	7014	No	No	No	Yes	Male	18-23	21	2) City Centre	70	5	30	5	Work & career		37
7014	7014	No	No	No	Yes	Female	24-29	28	2) City Centre	10	91	0	0	Partner		27
7014	7012	No	No	No	yes	Male	24-29	25	2) City Centre	25	30	40	5	Friends		23
7016	7491	No	No	Yes	Yes	Female	24-29	25	2) City Centre	90	5	5	0	Work & career		37
7018	7012	No	No	No	Yes	Female	24-29	28	3) City Periphery One	10	30	30	30	Equal priorities		Unknown
7020	7011	Yes	Yes	Yes	Yes	Female	24-29	27	3) City Periphery One	30	30	30	10	Equal priorities		Unknown
7021	7006	No	No	Yes	Yes	Female	46-55	53	3) City Periphery One	25	45	20	10	Partner		27
7022	7012	No	No	Yes	Yes	Male	24-29	27	3) City Periphery One	10	20	50	20	Friends		23
7023	7030	No	No	Yes	Yes	Female	24-29	29	3) City Periphery One	20	40	40	0	Partner		27
7030	7030	No	No	No	Yes	Male	24-29	28	2) City Centre	20	0	50	20	Friends		23
7030	7491	No	No	Yes	Yes	Male	24-29	29	2) City Centre	50	20	10	20	Work & career		37
7031	7050	No	No	No	Yes	Male	30-35	31	3) City Periphery One	35	28	22	15	Work & career		37
7031	7491	No	No	No	Yes	Female	18-23	23	3) City Periphery One	80	0	5	15	Work & career		37
7031	7031	No	No	No	Yes	Female	18-23	22	3) City Periphery One	Unknown	Unknown	wn	Unknown		0	Unknown
7031	7491	No	No	Yes	Yes	Male	24-29	24	3) City Periphery One	30	20	30	20	Equal priorities		Unknown
7032	7047	No	No	Yes	Yes	Female	24-29	29	3) City Periphery One	25	25	25	25	Equal priorities		Unknown
7033	7491	No	No	Yes	Yes	Male	24-29	29	3) City Periphery One	75	0	25	0	Work & career		37
7033		No	No	No	No	Male	30-35	30	3) City Periphery One	10	40	40	10	Equal priorities		Unknown
7033	7011	No	No	No	Yes	Female	30-35	31	3) City Periphery One	25	30	30	15	Equal priorities		Unknown
7040	7011	No	No	No	Yes	Female	30-35	32	4) City Periphery Two	20	40	30	10	Partner		27
7040	7011	No	No	Yes	Yes	Female	24-29	24	4) City Periphery Two	7	1	16	76	Experiences		13
7043	7036	No	No	No	Yes	Male	30-35	32	3) City Periphery One	10	30	30	30	Equal priorities		Unknown
7046	7004	No	No	Yes	Yes	Female			4) City Periphery Two	49	50	2	2	Partner		27
7049	7058	Yes	Yes	Yes	Yes	Female	30-35	34	5) Suburbs	15	50	25	10	Partner		27
7050	7034	No	No	Yes	Yes	Female	24-29	29	4) City Periphery Two	100	0	0	0	Work & career		37
7050		No	No	No	No	Female	24-29	25	4) City Periphery Two	100	0	0	0	Work & career		37
7050	7491	No	No	No	Yes	Female	18-23	22	4) City Periphery Two	30	0	50	20	Friends		23
7052	7037	No	No	No	Yes	Male	24-29	27	4) City Periphery Two	Unknown	Unknown	wn	Unknown		0	Unknown
7054	7000	Yes	Yes	Yes	Yes	Female	24-29	29	5) Suburbs	30	50	15	5	Partner		27
7054	7037	No	No	Yes	Yes	Male	56-65	58	5) Suburbs	30	30	20	20	Equal priorities		Unknown
7056	7032	Yes	Yes	Yes	Yes	Male	30-35	32	5) Suburbs	35	35	15	15	Equal priorities		Unknown
7042	7030	No	No	No	Yes	Male	30-35	30	2) City Centre	50	30	10	10	Work & career		37
7071		No	No	Yes	Yes	Male	24-29	26	5) Suburbs	40	30	20	10	Work & career		37
7072		No	No	No	Yes	Female	18-23	21	5) Suburbs	20	40	30	10	Partner		27
7075	7030	Yes	Yes	Yes	Yes	Female	30-35	31	5) Suburbs	10	60	15	15	Partner		27
7078	7041	No	No	No	No	Female	46-55	49	5) Suburbs	30	30	30	10	Equal priorities		Unknown
7081	7075	No	No	Yes	No	Female	46-55	56	5) Suburbs	50	30	10	10	Work & career		37
7081	7020	Yes	Yes	No	Yes	Female	24-29	28	5) Suburbs	10	30	35	25	Friends		23
7091	7014	Yes	Yes	Yes	Yes	Female	30-35	30	5) Suburbs	50	25	25	0	Work & career		37
7092	7093	No	No	Yes	Yes	Female	36-45	45	5) Suburbs	20	20	30	30	Equal priorities		Unknown
7350	7042	No	No	Yes	Yes	Female	24-29	29	6) Distant Commuters	40	40	10	10	Equal priorities		Unknown
7550	7006	Yes	Yes	Yes	Yes	Female	46-55	51	6) Distant Commuters	40	20	20	19	Work & career		37
7560	7053	No	No	No	No	Male	30-35	31	6) Distant Commuters	50	25	25	0	Work & career		37

Transport type: Biking	Transport type: Biking	Transport type: Bus	Transport type: Car	Preferred Transport	Transport type? Category Average	Timesaving	Economy	Health & personal reasons	Transport motivation: Category Highest Score	Transport motivation: Category Average
50	10	40	10	Walking	36	40	10	50 reasons	27	
Unknown	Unknown	Unknown	Unknown	0		20	30	50 reasons	27	
30	10	45	15	Bus	28	15	50	35 Economy	35	
30	15	50	5	Bus	28	40	30	30 Timesaving	38	
70	20	10	0	Walking	36	Unknown	Unknown	Unknown		
90	0	9	1	Walking	36	91	9	1 Timesaving	38	
5	80	15	0	Biking	13	30	60	10 Economy	35	
90	0	0	10	Walking	36	10	70	20 Economy	35	
35	15	50	0	Bus	28	15	65	20 Economy	35	
10	0	50	40	Bus	28	60	30	10 Timesaving	38	
20	25	10	45	Car	23	50	25	25 Timesaving	38	
5	1	20	74	Car	23	50	2	48 reasons	27	
20	20	0	60	Car	23	50	29	20 Timesaving	38	
70	20	10	0	Walking	36	50	30	20 Timesaving	38	
90	3	5	2	Walking	36	20	10	70 reasons	27	
35	0	60	5	Bus	28	30	70	0 Economy	35	
80	0	20	0	Walking	36	20	75	10 Economy	35	
50	5	46	0	Bus	28	Unknown	n	Unknown		
30	40	30	0	Biking	13	50	40	10 Timesaving	38	
70	0	5	25	Walking	36	20	20	60 reasons	27	
10	20	20	50	Car	23	80	0	20 Timesaving	38	
Unknown	unknown	Unknown	unknown	0		50	48	1 Timesaving	38	
20	1	60	19	Bus	28	16	54	30 Economy	35	
15	35	45	5	Bus	28	60	1	39 Timesaving	38	
5	0	75	20	Bus	28	17	80	3 Economy	35	
15	3	75	7	Bus	28	20	70	10 Economy	35	
24	24	26	27	Car	23	33	33	33 Equal priorities	Equal priorities	
60	5	5	30	Walking	36	10	60	30 Economy	35	
49	40	5	5	Walking	36	30	70	0 Economy	35	
50	0	50	0	Equal priorities	Unknown	67	0	33 Timesaving	38	
60	30	10	0	Walking	36	20	60	20 Economy	35	
25	70	5	0	Biking	13	40	40	20 Equal priorities	Equal priorities	
20	5	15	70	Car	23	79	10	10 Timesaving	38	
10	20	10	60	Car	23	60	10	30 Timesaving	38	
5	20	10	65	Car	23	60	20	20 Timesaving	38	
60	5	35	0	Walking	36	20	20	60 reasons	27	
25	30	35	10	Bus	28	5	40	55 reasons	27	
20	5	10	65	Car	23	70	20	10 Timesaving	38	
10	10	60	20	Bus	28	40	30	30 Timesaving	38	
20	3	11	76	Car	23	84	7	7 Timesaving	38	
Unknown	Unknown	Unknown	Unknown	0		40	20	40 Equal priorities	Equal priorities	
10	0	40	50	Car	23	45	50	5 Economy	35	
20	0	50	30	Bus	28	20	60	20 Economy	35	
20	0	60	20	Bus	28	20	60	20 Economy	35	
80	0	10	10	Walking	36	0	30	60 reasons	27	
79	0	20	1	Walking	36	0	0	100 reasons	27	
10	0	19	70	Car	23	75	25	0 Timesaving	38	