Globalization of Smart City "Living Labs": A Case Study of Toyota Woven City

Master Thesis

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Executive Summary

Creating smart cities is becoming an essential part of supporting the phenomenon of a global ageing population as well as combatting the challenges of the growing urbanization (Frem et al., 2018). Japan is creating strategies to combat these challenges as Japan is the most rapidly ageing society and the leader in the field of robotics and autonomy with a large growth in innovations and solutions. The ageing population is an issue which will present Denmark with future challenges, as Denmark is expected a doubling in senior citizens over 80 in in 2050. There are many initiatives for Denmark to consider from the Japanese context to combat the growing urbanization and ageing population, where Toyota Motor Corporation is currently creating the new smart city, "Toyota Woven City". Toyota Woven City will act as a case study for the thesis to investigate the considerations, which are important in successfully creating a smart city in Denmark.

The thesis makes use of an exploratory approach to do qualitative research by conducting in-depth interviews with industry experts from Denmark and Japan. To investigate the considerations of implementing Toyota Woven City in Denmark, theories on institutional isomorphism and recontextualization, on global, national, and organizational levels, along with stakeholder identification, stakeholder mapping, and Hofstede's cultural dimensions to analyze the gathered data. The thesis finds that there are considerations which can be recontextualized to have positive outcomes and used to gain a competitive advantage, considerations which can be recontextualized to have negative outcomes and need to be managed to not become obstacles, and lastly, considerations which recontextualize but are not deemed to have positive or negative outcomes or has little basis for isomorphic processes.

The researcher will take on the role of a consultant and act as a link between the Toyota Woven City project in Japan and implementing a Toyota Woven City project in Denmark where the results derived from the thesis should be viewed as critical considerations for successful implementation, should a smart city project be agreed to be developed in Denmark tomorrow.

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1. Introduction

What does the city of the future look like? Cities and communities around the world face challenges and issues, which will shape the future of what cities will look like. Globally, a rapid rate of expansion in urban areas is taking place with 55 percent of the global population currently living in cities (Frem et al., 2018). The number is expected to reach 68 percent by 2050, meaning an additional 2.5 billion people will live in cities, creating new and complex issues (ibid.). These issues will emerge, and the cities of today are likely to be on the cusp of the largest global economic transformation to date (ibid.). The increased population living in cities creates a pressure on the current cities' infrastructures in terms of transportation, housing, water, power, and city services (Falconer & Mitchell, 2012).

The growing urbanization presents key challenges. Cities occupy only three percent of the earth but account for up to 80 percent of energy consumption and 75 percent of global waste and carbon emissions (Frem et al., 2018). In addition to the growing urbanization, the world faces the phenomenon of an ageing population as people are living longer and healthier in some parts of the world. In 2020, 727 million people were aged 65 and above globally, which is a number expected to double by 2050, reaching over 1.5 billion people (United Nations, 2020). According to the United Nations report, by 2050, one in six people will be over the age of 65, which is an increase from 9.3 percent in 2020 to 16 percent in 2050 (ibid.).

This has spurred the rise of the usage of robotics and Artificial Intelligence[1] with smart solutions worldwide, especially in Japan, to support its ageing population and growing urbanization. To combat these challenges, smart cities are popping up in various areas around the world, as isolated, new projects or developed step-by-step from existing city landscapes with smart solutions and technologies. Creating smart cities has the ability to combat some of the challenges and make a difference by creating a more efficient infrastructure with the use of digital solutions and connectivity, which reduces emissions and increases citizens' quality of life (Frem et al., 2018).

Japan is creating strategies to combat the challenges of urbanization and the super-ageing population. Japan is the country, which has the most rapidly ageing society with 28.3 percent

[1] Will from here on out be referred to as "AI".

in the 65 or older group (Szczepura et al., 2020). The benefits of digitalization and AI have been at the core of improving healthcare and improved health in the distant future. Toyota Motor Corporation[2] is currently creating a new smart city from scratch, "Toyota Woven City[3]", which will demonstrate a human-centered approach to community development with new technologies to improve healthcare and mobility, such as automated driving, personal mobility, smart homes, robotics, and AI (Toyota Woven City, 2022). These smart features are created to help Toyota employees with their families to live more independently amidst the ageing population phenomenon and growing urbanization in a multi-generational city (ibid.).

In Denmark, it is expected that more than twice as many people will be over 80 years old in 2050 compared to the number of senior citizens in 2021, which makes the age group rise from 5 percent to 10 percent (The Local, 2021). The large increase in the number of elderly people is expected to present Denmark's social welfare system with economic challenges, with a large number likely to need care and practical help (ibid.). However, Denmark's entrepreneurial ecosystem is ranked number one in Europe and number fourth globally, scoring high on opportunity for technology absorption, with a long tradition of being at the forefront regarding the adoption of digital solutions as part of daily life and work (Invest in Denmark, 2018). The Danish entrepreneurial ecosystem creates interesting opportunities for a platform for smart cities and smart solutions in the Danish landscape. Thus, the thesis investigates which considerations go into successfully creating a smart city in the Danish landscape, using TWC in Japan as a case study for a smart city. It seeks to investigate considerations which go into moving TWC from one national context to another and from this deem which considerations are critical to make to achieve smart city success in a Danish context. Conducting the research for the thesis is interesting and contributes to literature since it will provide a set of guidelines of which considerations have positive advantages and which have negative implications from recontextualization into a Danish context should Denmark wish to create a smart city project tomorrow. Additionally, the thesis contributes to literature by investigating the TWC case, which has yet to be studied and investigates moving a smart city as a whole into a new national context looking into the aspects that recontextualizes and thus, which considerations are important to make in a new context. The research from the case study can be viewed as an example of what to do and what not to do when creating a smart city in a Danish context.

[2] From here on out referred to as "Toyota"
[3] From here on out referred to as "TWC".

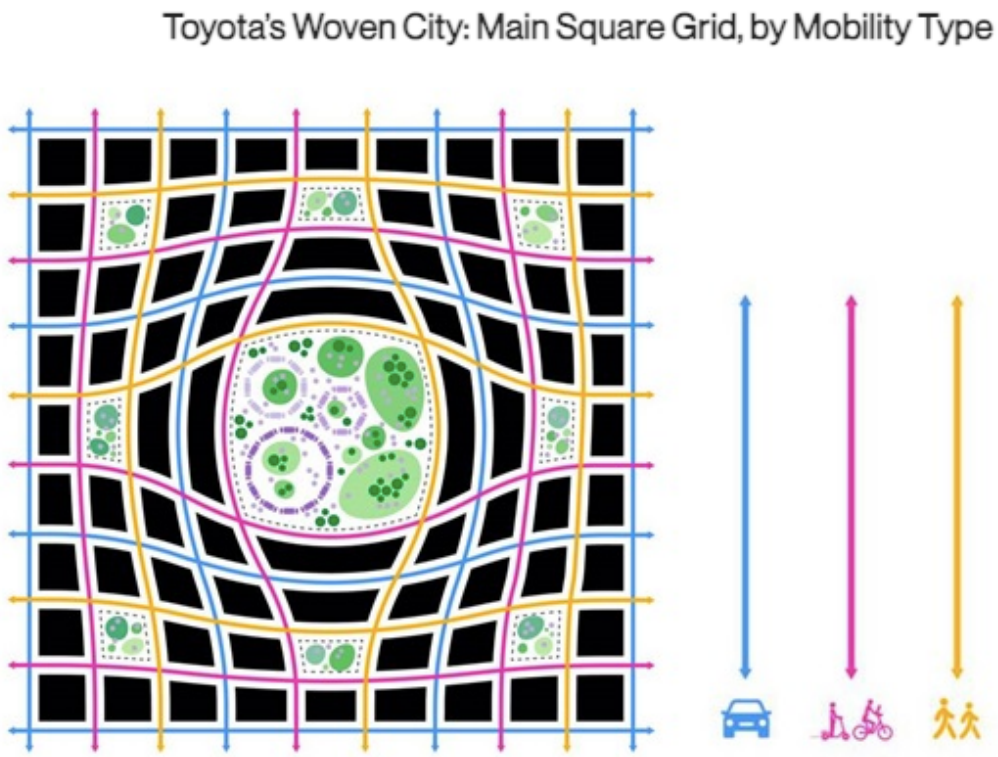
1.2 Case background) Introducing Toyota Woven City: a prototype city of the future

Toyota is a global mobility company founded in 1933 with more than 1,000 subsidiary companies and affiliates involved in production (Toyota, 2021). Toyota builds around 10 million vehicles per year in 28 countries and sells in more than 170 countries under the brands Toyota, Lexus, Daihatsu, and Hino (ibid.). To broaden its scope to include everyday mobility of people, goods, and information, Toyota is creating a new smart city, TWC, from the ground up on a former factory site (Toyota Woven City, 2022). The TWC project was supposed to begin construction in 2020, however, it was delayed due to Covid-19 and instead broke ground in February 2021 and is currently expected to open around 2024-2025 (Aikawa, Appendix 1).

Located at the 75-acre former Toyota factory site in the city of Susono in Shizuoka, at the foothills of Mt. Fuji in Tokyo, Japan, TWC will be the world's first urban incubator dedicated to the advancement of all aspects of mobility (BIG, 2022). President Akio Toyoda explained that TWC "… marks a very special new chapter in our story, in the industry, and in our future. Here at the base of beautiful Mt. Fuji, it is worth remembering that every mountain top is within reach" (Toyota Woven City, 2022). Mt. Fuji holds a lot of meaning for the Japanese citizens and the ceremony for the date marking the groundbreaking ceremony for TWC, *jichinsai*, was February 23rd, 2021, which is also known as "Mt. Fuji Day" in Japan (ibid.). TWC is referred to as a prototype city of the future on a 175-acre site, which will serve as a multi-generational isolated smart city project (Toyota, 2022). Toyota plans to populate the smart city with Toyota employees and their families, retired couples, retailers, visiting scientists, and industry partners, which initially will be 2000 citizens, but more will be added as the city evolves over time (ibid.).

Source: Toyota Woven City website, screenshot from video (2022).

TWC is pioneering a profound evolution in how societies of the future live, work, play and move, based on three principles: "Human-Centered" respect and prioritization of people's needs and preferences, "Living Laboratory", which enables seamless real-world testing of new technologies, and an "Ever-Evolving" approach by which such new technologies and services continuously grow and improve (Toyota Woven City, 2022). TWC will be "a place where researchers, engineers, and scientists from around the world could come together to test and develop new technologies, such as Autonomy, Robotics, AI, and more" (Akio Toyoda, Toyota Woven City, 2022). TWC takes its symbolic and metaphorical name from both its concept and design as the city will have a flexible, "woven" network of streets split into three tracks dedicated to various speeds of mobility (BIG, 2022). The concept of three-split woven roads, according to mobility, offer potential for less congestion, improved safety, and higher levels of integration with nature (Citron, 2020).



Source: Bjarke Ingels Group (BIG), 2020.

The primary street will be optimized for faster autonomous vehicles with logistical traffic underneath, visualized in the above imagine in blue. Here, the driverless multi-purpose vehicle, Toyota E-Palette, will be used for shared transportation and delivery services, as well as for mobile retail, food, medical clinics, hotels, and workplaces (BIG, 2022). The secondary street, the recreational promenade (visualized in pink), will be occupied by micro-mobility types of personal transportation, such as bicycles, scooters, and others including Toyota's i-Walk (ibid.). The third type of street will be a linear park designated for pedestrians, flora, and fauna (visualized in yellow), providing a safe and pleasant environment with nature breaks by connecting Mt. Fuji to the Susono Valley (ibid.).

Source: Toyota Woven City website (2022).

Under the smart city, in an underground network, lies the infrastructure, including hydrogen power, stormwater filtration, and a goods delivery network dubbed the "Matternet", which will be a city-wide urban drone logistics platform (BIG, 2022). TWC is planned to be fully sustainable utilizing solar energy, geothermal energy, and mostly hydrogen fuel cell technology to strive towards a carbon neutral society (BIG, 2022). The buildings will also be sustainable, made by wood to minimize carbon footprint, using traditional Japanese joinery, combined with robotic production methods, to merge traditional Japan with the future (Toyota, 2022). To quote the president of Toyota (Akio Toyoda), Toyota's dream is "to create a place where people live, work, and play in a real-world living laboratory" (Akio Toyoda, Toyota Woven City, 2022). Even though Covid-19 has caused delays to the project, Toyota's dream of TWC is well on its way to coming true.

1.3 Problem formulation

Toyota's TWC project will be demonstrated as a case study for the thesis, as a "living lab", with a human-centered approach to community and smart city development. The thesis aims to investigate which considerations are important when creating a smart city in Denmark, using TWC as a case study, to investigate whether the considerations gain a new meaning in a Danish context and what are the criteria from these considerations, which are important to make to

successfully implement TWC into a Danish context. The researcher will take on the role of a consultant by acting as a link between the TWC project in Japan and implementing it in a Danish context should a smart city project be agreed to be developed in Denmark tomorrow. The researcher acts as a consultant and the thesis can therefore act as a guideline for the day Denmark decides to develop a smart city in Denmark in showing which considerations are important for project success.

Thus, the aim of the thesis boils down to exploring the considerations, which are important to create a smart city a Danish context by using "Toyota Woven City as a case study. The thesis will have a focus on four themes; investing in Denmark, robotics & AI, sustainability, and the idea of a futuristic city, derived from the expertise of the interview subjects, who were interviewed for the purpose of the thesis.

1.3.1 Research question

The following research question is posed:
What are the factors which should be considered when implementing a Toyota Woven City inspired smart city into the Danish landscape?

Sub-question:
From the factors, which considerations are critical for successful implementation of a Toyota Woven City inspired smart city in a Danish context?

The questions will focus on the four themes: investing in Denmark, robotics & AI sustainability, and the idea of a futuristic city. The questions will be answered through the analysis of interviews with industry leaders and individuals with backgrounds and expertise, which translates into creating a smart city in a Danish context where the researcher takes on the role of a consultant.

2. Method

2.1 Research Approach

The thesis makes use of a qualitative method approach by collecting primary data through eight semi-structured interviews (Kvale, 2007). The thesis was performed through an inductive approach where understanding and theories were developed through the gathering and

examination of primary data as opposed to a deductive approach, which confirms or rejects existing theory and testing of hypotheses (Veal & Darcy, 2014). The project follows an exploratory research approach to investigate the considerations related to moving the TWC project into a Danish context and gain insights and understanding where explanations were induced from the gathered data (Malhotra, Nunan, & Birks, 2017). The exploratory design was chosen as a suitable approach for the thesis as the research question sets out to investigate the considerations from TWC, which can be implemented into the Danish landscape, looking into which considerations are critical for project success.

2.2 Research Design

Based on the problem formulation and research question at hand, an exploratory, descriptive, or causal design needs to be considered (Nunan, Birks, & Malhotra, 2020). The research for the thesis follows an exploratory research design in its nature since it investigates a phenomenon, which is why the exploratory approach was deemed most optimal (Malhotra et al., 2017). Additionally, the exploratory approach makes room for creativity, adaptability, and flexibility, which was deemed to be the most optimal approach, due to the changes in plans throughout the research process and the access to gathering of primary data (ibid.). To investigate the research question and the considerations in developing a smart city project in a Danish context, the researcher chose to make use of case study research as a strategy where TWC was chosen as the case study to delimit the aspects involved in creating a smart city. By doing so, it enables the researcher to investigate the phenomenon at hand in a real-world context as a point of origin (Nunan et al., 2020).

2.3 Data collection methods

2.3.1 Primary data collection

Due to the spread of Covid-19 during fall 2021, a plan A and plan B for gathering primary data were prepared ahead of time to ensure successful data collection. As the original aim of the thesis was to investigate moving the TWC project to a Danish context in relation to the elderly population in Denmark, plan A included a research trip to Japan to visit and make observations of the TWC project site along with interviews with residents at several nursing homes in Denmark, which were both unsuccessful due to Covid-19. Local Covid-19 restrictions were being issued in Japan and the emergence of the Omikron variant tightened safety measures for outside to enter (Dujarric, 2022). Most foreigners were banned from entering Japan until April,

and Japan were one of the world's most difficult countries to enter, enforcing "Sakoku", which is travel ban with a policy name stemming from the 17th-19th centuries used by xenophobic warlords (Asahi, 2022). The strict zero-Covid policy was dubbed "Neo Sakoku" as a reference to the old policy name (ibid.). The border rules allowed only Japanese nationals and permanent foreign residents to enter as Japan coped with a record surge of Covid-19 cases in Tokyo and other major cities (ibid.). It was also not possible to gather research from nursing homes in Denmark as Denmark also saw its height in Covid-19 cases from late November to March (Worldometer, 2022).

With no prospects of entering Japan or nursing homes in Denmark, the researcher resolved to carry out plan B, which involved conducting in-depth interviews with industry experts online or at the local workplaces. As Denmark also saw its height in Covid-19 cases from late November to March, the interviews ended up being carried out online via MS Teams due to the uneasiness and wariness from the interview subjects of conducting interviews face to face. A mixed method approach would have been favorable for the purpose of answering the research question with both interviews and observations of the TWC project. However, a mono-method approach, consisting of just qualitative data, was deemed sufficient even though in-person observations of the making of TWC and internal statistics would have been useful for the aim of the thesis.

2.3.2 Semi-structured Interviews

The thesis aims to research the TWC project in Japan and investigate the considerations which are important when creating a TWC project in a Danish context and which are critical for project success. Data collection, in the form of eight semi-structured depth-interviews, were prepared to be gathered in January through March to ensure completion and time to analyze the findings. The in-depth interviews were unstructured, direct, and personal in which the interview subjects were probed to uncover their underlying motivations, beliefs, attitudes, and feelings on areas of the research question for the thesis (Malhotra et al., 2017). Data was sampled through individual in-depth interviews with relevant industry experts who had areas of expertise for investigating the posed research question. The semi-structured interview approach was chosen as it allowed for the questions to be asked in a more flexible manner where the interview had more flow with a premade interview guide where the questions were not asked in a specific order (ibid.). Not following a standardized set of questions allowed the

researcher to ask follow-up questions depending on the answers and general direction of the conversation (ibid.).

Due to the spread of Covid-19 in Denmark during the winter months, the in-person interviews were conducted online via Microsoft Teams. One interview, with Aikawa from Toyota, was conducted via e-mail since her answers needed hierarchical approval by higher-ups as the TWC project is still in its starting phases and will at the earliest be finished 2024-2025 (Appendix 1). The remaining in-person online interviews lasted between 21 and 45 minutes and were recorded both on Microsoft Teams and as voice memos.

2.3.3 Interview subjects

The initial interview subjects were selected due to their industry expertise and knowledge in areas regarding the topic of smart cities and implementation of TWC into a Danish context. The interview subjects had various expertise areas, which fit well into the aim of the thesis, that allowed for the researcher to gain perspective and insight into the various focus areas, which were important when considering the implementation of TWC in a Danish context.

See the overview below of the interview subjects for the research project:

Name	**Title**	**Company**	**Date of interview**	**Type of interview**	**Interview number**
Sonomi Aikawa	Toyota spokeswoman. PR Manager in Toyota Woven Planet's global PR team.	Toyota Woven Planet/City.	14th of January 2022.	Ongoing e-mail interview.	1 out of 8.
Anne Hougaard Jensen	Director, Invest in Denmark.	Invest in Denmark. The Danish Embassy.	20th of January 2022.	Online via Microsoft Teams. 31:18 min.	2 out of 8.
Alexander Matthias Jacobson	Climate and Computational specialist. Toyota Woven City project.	Bjarke Ingels Group (BIG).	27th of January 2022.	Online via Microsoft Teams. 38:16 min.	3 out of 8.

Steffan Skoubo Elcer	Digitalization consultant. Coordinator for Smart City Odense.	Invest in Odense.	2nd of February 2022.	Online via Microsoft Teams. 23:06 min.	4 out of 8.
Casper Dahl Marcussen Craggs	Investment manager in Robotics.	Invest in Odense.	3rd of February 2022.	Online via Microsoft Teams. 21:39 min.	5 out of 8.
Teddy Sibbern Axelsen	Head of Doll Living Lab, We Build Denmark, and Gate 21	Doll Living Lab.	17th of February 2022.	Online via Microsoft Teams. 45:46 min.	6 out of 8.
Gitte Krusholm Nielsen	CEO of Danske Tegl. Former marketing manager in MT Højgaard and Alectia	Danske Tegl.	7th of March 2022.	Online via Microsoft Teams. 42:10 min.	7 out of 8.
Nakajima Kensuke (中島 健祐)	Social Innovation Evangelist in Mitsubishi UFJ. Former head of investment department at the Royal Danish Embassy in Tokyo.	Mitsubishi UFJ Research & Consulting Co., Ltd. Social Impact Partnership Business Dep.	9th of March 2022	Online via Microsoft Teams. 38:48 min.	8 out of 8.

Table 1. Interview subject overview. Own depiction (2022).

Following the third interview, with Jacobson, the sampling process allowed for a non-probability, "snowball" sampling method as the initial interview subjects expressed insight to whom should be targeted to gain the desired expertise (Malhotra et al., 2017). Aikawa, Jensen, and Jacobson were the three initial interview subjects who were chosen using judgement sampling from the researcher's judgement as all three would offer expertise and insight into key areas. To this, Aikawa offered insight into the Toyota corporation and the TWC project, Jensen offered insight into the considerations that goes into creating a new project in a Danish

context, where Jacobson offered insights into the TWC project and innovation in building smart cities from his background in BIG, the architect firm in charge of TWC. In terms of access, Aikawa was reached through an inquiry to Woven City, Jensen was reached through the Danish Embassy's website, whereas Jacobson was reached through LinkedIn Premium.

From here, the sampling process followed the mentioned "snowball" method as the initial group of interviewees expressed insights or were asked to identify other potential subjects who had expertise in the target areas of interest; smart and futuristic cities, robotics, AI, investments in the Danish landscape, construction, or sustainability (Malhotra et al., 2017). Jensen suggested reaching out to the director of Invest in Odense, Joost Nijhoff, who instead put the researcher through to the interview subjects Elcer and Craggs. Elcer suggested that the interviewer reached out to the interview subject Axelsen who then put the researcher through to the next interview subject, Nakajima. A. Nielsen were initially reached out to via LinkedIn Premium using judgemental sampling due to her background as a Danish futurist, who instead put the researcher through to the interview subject G. Nielsen. The interviews were expected to be finished in February, however, due to the snowball sampling method, two of the eight interviews were conducted in early March, as the time for new respondents to answer was longer than first anticipated. The judgemental sampling process, which moved into the snowball sampling process, and the links between the interview subjects is depicted in figure 1 below.

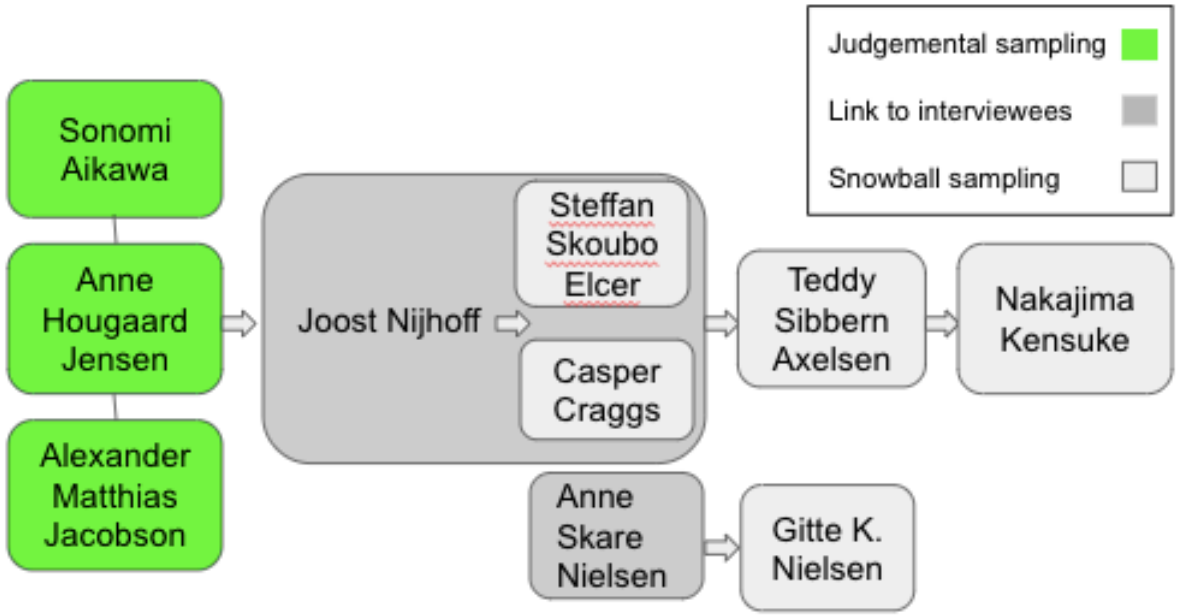


Figure 1. Visualization of the sampling process. Own depiction, 2022.

2.3.4 Interview guide

The eight semi-structured interviews were performed based on a pre-made interview guide, which was sent to the interviewees a minimum of three days prior to the interview. The interview guide consisted of 21-26 unstructured questions, which were open-ended questions for the interview subjects to be able to answer in their own words as an effort to minimize bias or influence from the interviewer (Malhotra et al., 2017). The unstructured questions acted as enablers for the interview subjects to express their general opinions and attitudes for the interviewer to interpret and enabled the interview subjects to express what they felt to be important (ibid.).

For all interview subjects, the interview guide contained general questions regarding themes such as: attitudes, the Danish context for the creation of a smart city, necessary efforts to implement a smart city, smart solutions, sustainability, robotics, mobility, stakeholders, challenges in implementing a smart city, and the overall idea of a futuristic city in Denmark. All the interview guides had seven themes, which were: interview subject background, smart cities, Toyota Woven City, attracting Danish and foreign stakeholders, attitudes towards a smart city in Denmark, citizens, and miscellaneous. The miscellaneous consisted of a handful of questions, which differed according to the individual interview subject's expertise and background. As an example, Craggs had additional questions which were specific to robotics and AI, whereas Jacobson had additional questions which regarded the city structure and sustainability aspects as an architect, whereas Nielsen had additional questions regarding construction of a smart city. To get the most out of the interview subject's expertise, individual interview guides were constructed for each interview subject according to their individual backgrounds.

2.3.5 Secondary data collection

Primary data was used as the main source of data used for the purpose of answering the research question at hand, however, a certain amount of secondary data was gathered as well. Secondary data was easier obtainable and was available when other sources of primary data were not able to be obtained. Secondary data for the thesis provided background information and insights, which consisted of both qualitative and quantitative data. Qualitative data gathered for the thesis included theoretical frameworks, academic journals and papers, articles from newspapers, and information associated with TWC from websites and videos such as: Toyota

Times, Toyota Woven City, and Bjarke Ingels Group (BIG[4]). Unfortunately, it was not possible for quantitative data to consist of relevant annual reports as TWC has yet to be completed. However, various statistical analyses and market reports were used for the aim of the thesis, such as Nitto, Taniyama, & Inagaki's (2017) statistical report on "social acceptance and impact of robots and artificial intelligence" and the McKinsey report on "thriving amid turbulence: imagining the cities of the future" (Frem et al., 2018).

2.4 Coding and data structuring

Sensemaking was used as a diagnostic tool in the analysis of qualitative data through open coding to determine how to best interpret the data to be examined and decide which approach to adapt to make sense of the findings (Paull et al., 2013). Sensemaking was used by the researcher as a lens to explore the transcribed interviews as a means to make sense of the experience and understand the similarities and themes spurring from the interviews.

Open coding was used to analyze the transcribed interviews with the industry experts as it is a method where the researcher does not have a preconceived notion of the themes or answers to look for, making the method data-driven (Gibbs, 2007). The open coding method was used to analyze the transcribed interviews by color-coding passages, sentences, and words from each interview, which were deemed relevant for the thesis and then grouped into recurring themes by which concepts reoccurred between the interviewees (ibid.). From the eight transcribed interviews, the reoccurring color-coded elements were derived to consist of 11 concepts: OPP-models, stakeholders, attracting investors, SDGs, sustainable construction, green energy and CO2 reduction, smart mobility, digitalization of cities, digital trust, attitudes, and branding. The 11 concepts were systemized into four overall themes deemed relevant for considerations in moving TWC to a Danish context, which were: investing in a TWC project in Denmark, sustainability, robotics & AI, and the idea of a smart city. The structure for the coded data, set up in figure 2 below, was inspired by the three-order framework from Gioia, Corley, & Hamilton (2013) for structuring qualitative data (Gioia et al., 2013). The 11 concepts grouped into four themes are visualized in figure 2 below and further described subsequently:

[4] From here on out referred to as "BIG".

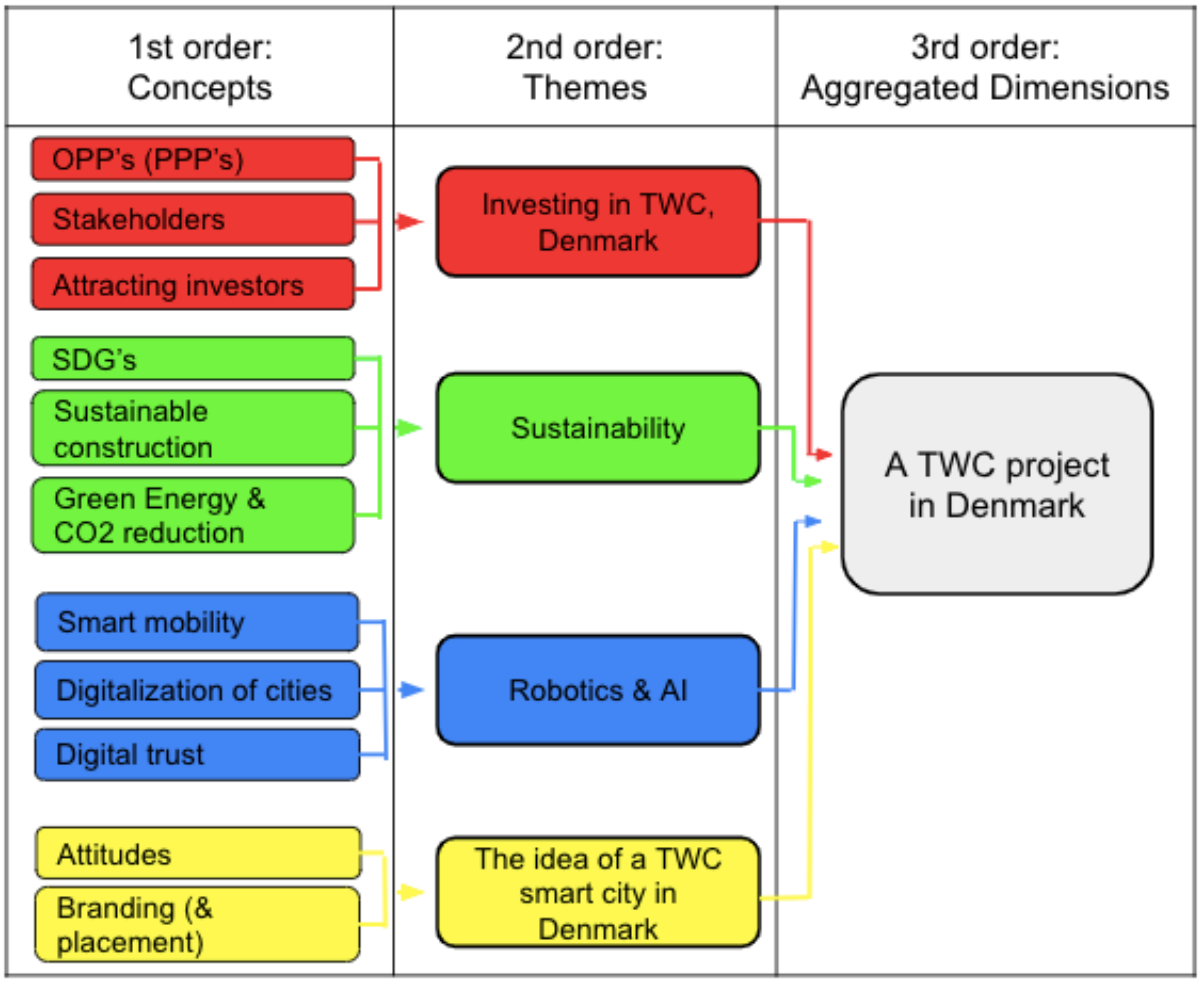


Figure 2. Own depiction (2022) of data overview, inspired by Gioia et al. (2013).

The framework from Gioia et al. (2013) is comprised of three orders where the 1st order consists of concepts where the researcher tries to recognize recurring concepts directly from the informants' wording and passages in the interviews and then clustered into concepts by similarity and relevance (Gioia et al., 2013). The 2n2 order consists of themes where the researcher connects the concepts from the 1st order to theories, where the concepts were connected with Jayasena's concept model for smart city stakeholder identification (2019), Mendelow's Power/Interest stakeholder mapping (1991), and Hofstede's cultural dimensions and lastly the 3rd order consists of aggregated dimensions (1983) (ibid.). The themes from the 2nd order were then linked to the root phenomena in the 3rd dimension, the creation of a TWC project in a Danish context, which is presented as the aggregated dimension (ibid.). The three orders presented in figure 2 serve as a means to visualize the coding of data as well as how the themes will serve as a framework to be used in the analysis (ibid.). The visualization shows the

steps from raw data to concepts and themes as well as provides the reader with a clear overview of information gathered through interview transcription without having to read through it.

2.5 Language

The primary language used during data collection was conducted in English. As the researcher's mother tongue is Danish as well as proficient in Japanese, the researcher also made use of Danish and Japanese in gathering primary and secondary data, such as Japanese websites and news articles. The Danish language was used in relation to conduct interviews with Danish interview subjects whereas the English language was used to conduct interviews with the international interview subjects Aikawa, Nakajima, and Jacobson, who preferred the interview to be conducted in English over Danish or Japanese, which was agreed to prior to the interviews. Even though Jacobson lives in Denmark and is proficient in Danish, he originates from LA and as a native English speaker preferred the interview to be conducted in English. The interviews with Aikawa and Nakajima were conducted in English as it was preferred by the interview subjects to minimize misinterpretation where Japanese was used regarding explanations when needed. Using a multitude of languages, according to each interview subject, was performed as an effort to create a comfortable and relaxing setting for the interview subjects, which allowed the researcher to investigate and gain insight in the most natural way for the interview subjects. The researcher was not able to use Japanese to the intended extent as the researcher was unable to make observations of the TWC worksite or interview more Japanese Toyota workers. The three languages were also used when gathering secondary data for the thesis.

2.6 Participant influencing

To create a common ground and the most optimal setting for transferring and exploiting knowledge and communicating with the interview subjects, each interview began with a preliminary dialogue where the researcher communicated the aim of the research, the research question, and the interview subject's role in gathering answers. The optimal setting was also ensured by providing the same explanations in e-mails beforehand as well as a pre-made interview guide, which was provided for the interview subjects a minimum of three days before the planned interviews. When choosing the wording, the researcher made it of great importance to carefully make an effort to not put the researcher's bias into the interview subject's answers. Even though one of the three principles to TWC's approach involves "Living Laboratory", the

wording could have created a negative setting (such as the association to laboratory rats or guinea pigs for testing) when describing the city to the interview subjects and thus, "multigenerational futuristic city" was used with the two other TWC principles "Human-Centered" and "Ever-Evolving" (Appendix 18). Even though the researcher made great effort to create a neutral description for the TWC project where "living lab" and "surveillance" was excluded and instead TWC was described as a "test-site" or "multigenerational, futuristic city" that "enables testing of new technologies" (ibid.). However, when collecting empirical data through interviews, it was not possible to not create some influence on the interview subjects' answers, which is the case in qualitative studies where answers are influenced by the researcher (Kvale, 2007). This happens as the interview subjects were directly asked to answer specific questions and follow-up questions, which entails a certain amount of influence from the researcher (ibid.). Even though the researcher made great effort to provide a neutral description and impression of TWC, some of the interview subjects explained that they had looked up TWC themselves and especially two interview subjects expressed negative opinions regarding TWC and the "living lab" principle such as stating, "I'm not quite sure if I would be happy to live there myself as a guinea pig" (Elcer, Appendix 4, p. 35). The results and findings are still deemed valid as the answers are the interview subjects' opinions and thus, what they believe to be true (Baumann, 1999). It was therefore not possible for the researcher to not influence the interview subjects during the interview period, however, TWC's website and information is freely available to all, which is an aspect the researcher had little control over.

2.7 School of thought and inductive approach

The research for the thesis was conducted within the interpretivist paradigm through an inductive approach where data is allowed to move in its own direction (Malhotra et al., 2017). The chosen approach is the opposite of the positivist paradigm, where specific variables are identified, and hypotheses are set where the conclusions are reached based upon agreed and measurable "facts" (ibid.). The positivist paradigm seeks to establish legitimacy of his/her approach through a deductive approach where hypotheses are created before data collection and the positivist tests theory according to whether their hypotheses are accepted or rejected (ibid.). However, for this thesis, the interpretivism paradigm was chosen to allow data to evolve in its own direction instead of working with a developed hypothesis prior to data gathering through an inductive approach. The interpretivist paradigm approaches research through induction, which does not close off the possible outcome, by identifying the area of

investigation but not creating hypotheses or limiting investigation by restrictive theoretical frameworks (ibid.). The broader themes were identified through interviews, discussion, and in-depth questioning with the interview subjects to further elaborate the nature of the themes to aid in investigating which considerations are important in implementing TWC into the Danish landscape (ibid.). The theoretical framework for the thesis was developed by searching for occurrences and interconnected phenomena (ibid). From the interviews, the researcher developed a model and the theoretical framework based upon the interviews to explain and answer the phenomena in question (ibid.). The validity of the interpretivist approach is based upon "fair samples" where tackling large "representative" samples is generally impossible, which makes the validity dependent on the quality of data and representatives (ibid).

2.8 Validity and reliability

As mentioned in the school of thought section, the reliability and validity of the research for the thesis is dependent on the empirical data due to the influence and bias of the researcher in conducting the interviews (Malhotra et al., 2017). Malhotra et al. explains that there will always be a certain amount of subjectivity when collecting data in terms of conducting interviews as an interviewer will always present, which also means that bias is unable to be completely eliminated (ibid.). Knowing this fact prior to the interviews, the researcher implemented a certain amount of caution to not express personal opinions during the interviews, sway opinions, put words into the interview subjects' mouths, or use negatively charged words, such as describing TWC as a futuristic city instead of "living laboratory" as explained on TWC's homepage. The interviews were conducted via MS Teams due to the current worldwide Covid-19 situation, thus adding video to the calls, to which the online interviews gained more validity by establishing trust and a more personal relationship between the interviewer and interviewee through visual contact. The level of trust could not have been achieved should the interviews have been conducted only with audio, which could have had an impact on the opinions and answers provided. Additionally, through visual contact, non-verbal cues and communication could be observed to ask following-up questions, sensing the pace of the responses from the interview subjects, or add further elaboration. Had the interviews been in person, mutual trust could have been achieved through formal greetings, small talk, handshakes with the Danish interview subjects or exchanging business cards, *meishi koukan* (名刺交換), with the Japanese interview subjects, which is a characteristically Japanese custom (Wa-shoku, 2020).

According to Kvale (2007), reliability refers to "how consistent the results are" and validity refers to "whether an interview study investigates what it is intended to investigate" (Kvale, 2007). Had there been access to a larger pool of interview subjects within the timeframe of the thesis, the researcher could have gained additional insight or aspects to the thesis, or it could have gained a higher level of consistency in answers. To check the consistency and validity of the answers from gathered interviews, the interview subjects' statements were researched when used in relation to the four themes throughout the analysis. Through the usage of multiple languages and the sampling process following a "snowball" method, it allowed the researcher to gain interview access with the right experts for the sake of the thesis, which makes for the possibility of other researchers gathering non-identical data. However, this aspect enabled the access and completion of interviews with interview subjects whose background and expertise fit exactly for the research of the thesis, thus increasing the quality of the data.

2.9 Limitations

As the TWC project has yet to be completed during the timeline of the thesis, additional technologies and improvements can be developed and evolve even after the thesis is completed and will not be accounted for. Additionally, due to the completion date for TWC being years away (2024-2025), it was not possible to gather much quantitative data from TWC employees, where the answer was "We are not at a stage to communicate other details" (Aikawa, Appendix 1, page 3).

It was not possible to enter Japan and conduct primary data due to local Covid-19 restrictions and travel ban to Japan, which posed an obstacle to efficiently gather primary data in the fashion best suited for the thesis. This aspect limited information gathering and the interview process in collecting data. As described in the validity and reliability section, a higher level of mutual trust could have been achieved through in-person interviews, however, using video call established a certain amount of trust and personal relationship. Thus, the greatest limitation was due to Covid-19 restrictions and travel bans, which made information gathering, observations, and in-person interviews a loss of dimension for the research of the thesis. Even in Denmark, the researcher was unable to visit the local interview subjects at their workplace due to the high record number of infections in Denmark, which made the interview subjects uneasy for in-person meetings (Worldometer, 2022). Using an inductive approach, a multitude of potential interview subjects were reached out to using judgemental or snowball sampling,

however, with no luck. Had the potential interview subjects replied or had time for interviews, it would have provided the thesis with even more reliability and context.

3. Theoretical Framework

The following section will include a short explanation and review of the theoretical frameworks, which was deemed most appropriate for investigating the posed research question and the conduction of research in relation to moving the Japanese TWC project to a Danish context. The theory section was divided into main and supportive theories where DiMaggio and Powell's Institutional Isomorphism (1983) theory and Brannen's recontextualization (2004) theory were used as main theories and Clausen's multi-communication model (2006), Jayasena et al.'s stakeholder identification (2019), Mendelow's power/interest grid for stakeholder mapping (1991), and Hofstede's Cultural Dimensions (1983) were used as supportive theories.

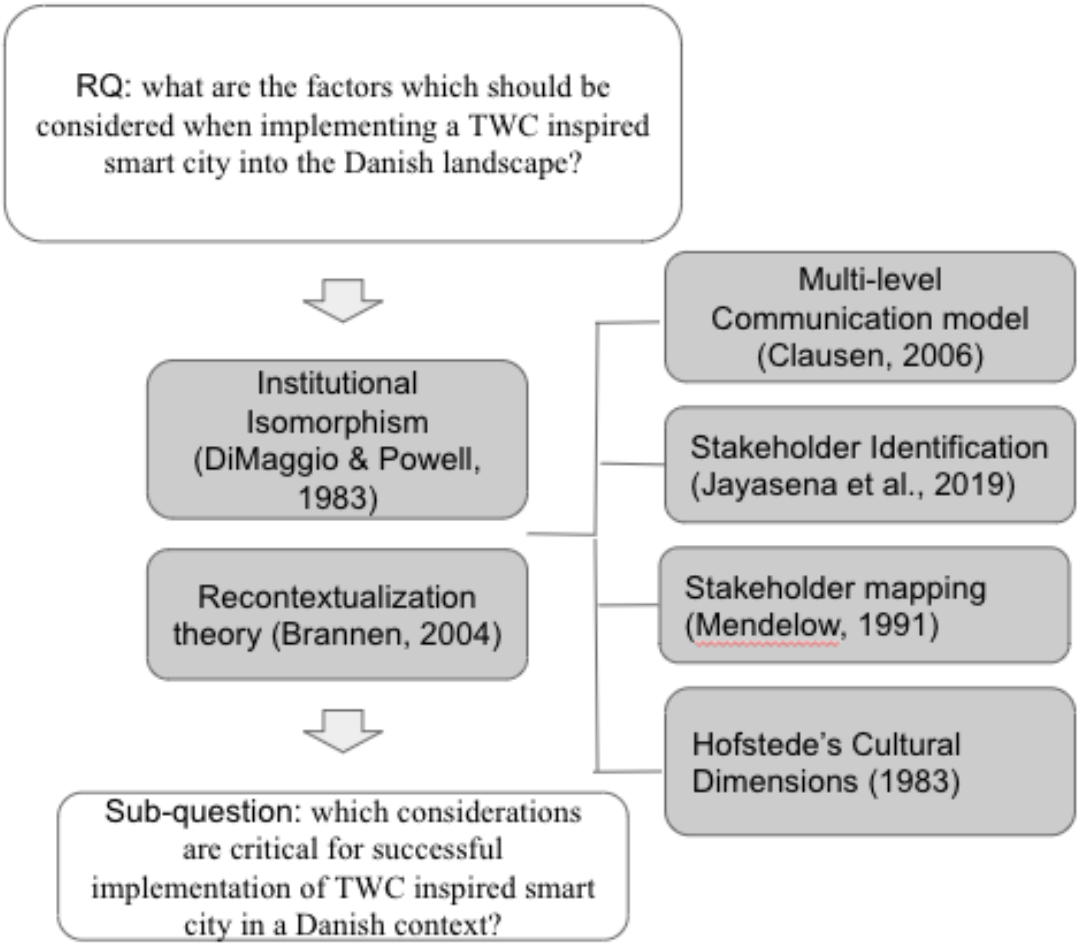


Figure 3. Theoretical Framework. Own depiction, 2022.

3.1 Main theories

3.1.1 Institutional Isomorphism (DiMaggio & Powell, 1983)

The concept "Isomorphism" is derived from population biology and mathematics, however, is additionally applied to institutions and organizations to understand the constraining process, which forces one unit in a population to resemble other units that face the same set of environmental conditions (Thornton, 2011). "Isomorphism" is derived from the Greek "isos", meaning equal or identical, and "morph", meaning form or appearance, which combined constructs the word isomorph, meaning something which has the same form of another but belongs to a different group (ibid.). Isomorphism occurs in two types, *competitive isomorphism,* and *institutional isomorphism*, where competitive isomorphism refers to competition among organizations in an organizational field for resources and customers, the economic fit, whereas institutional isomorphism refers to the quest for political power and legitimacy and the concept "institutional isomorphism" is at the core of institutional theory, explaining the homogeneity of organizations in a field (Pal & Ojha, 2017). Institutional isomorphism will be used in this thesis to explain the homogeneity in moving the TWC project to a Danish context as a whole.

The Oxford dictionary explains an institution as "an organization funded for a religious, educational, professional, or social purpose", since an institution is established when enough people are devoted to practicing its purpose (Oxford University Press, 2022). Institutions are referred to by North (1991) as "the humanly devised constraints that structure political, economic, and social interaction. They consist of both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, property rights)" (North, 1991). North further explains that informal institutions are diverse and broad in its contents and not determined by authorities whereas formal institutions are formally created to create order and structure for citizens to obey (ibid.).

The concept of institutional isomorphism in organizational fields was developed by Paul DiMaggio and Walter Powell (1983), with a framework which presented the three different mechanisms through which isomorphism occurs, including coercive, mimetic, and normative isomorphism (ibid.). Coercive isomorphism stems from political influence and the problem of legitimacy, mimetic isomorphism results from standard responses to uncertainty, and

normative isomorphism is associated with professionalism, where the "three types are not always empirically distinct" (DiMaggio & Powell, 1983).

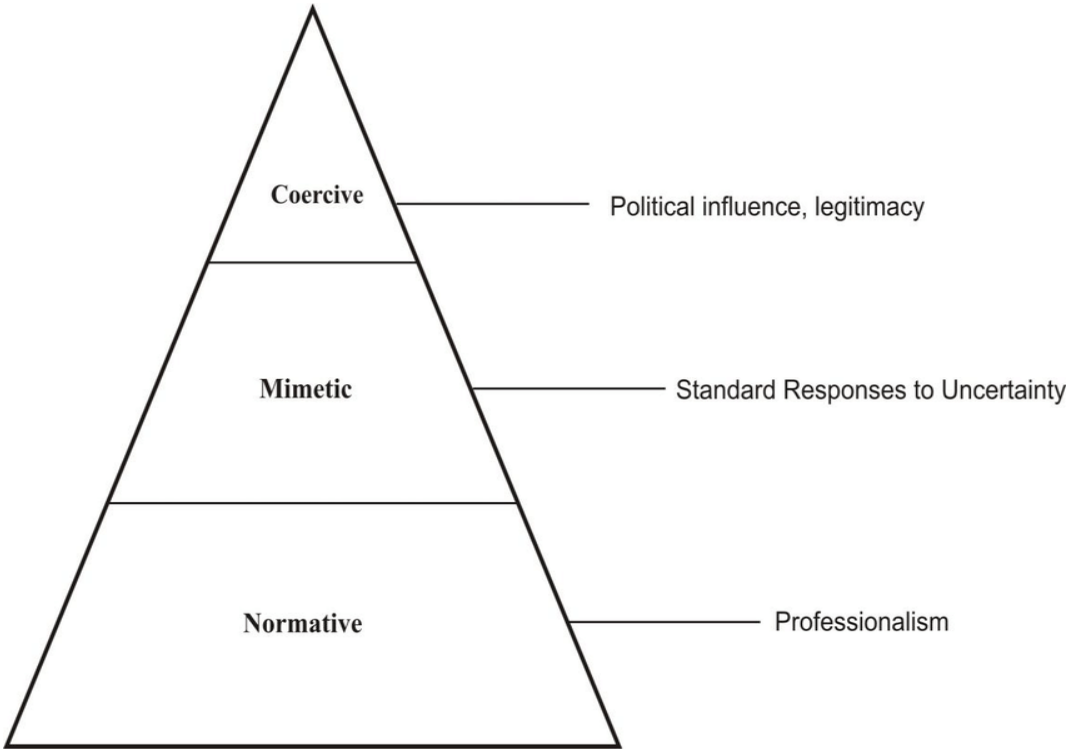


Figure 4. Institutional Isomorphism. Source: DiMaggio and Powell, 1983.

As the concept "institutional isomorphism" explains the homogeneity of organizations in a field, according to Pal & Ojha (2017), and focuses on the enabling effects that formal and informal rules take on individuals and groups and cultural and cognitive explanations where recontextualization occurs when transferred assets take on new meanings in new cultural recipient contexts (Dimaggio & Powell, 1983). Isomorphism occurs when "organizations model themselves on other similar organizations that they perceive to be more legitimate or successful" whereas recontextualization is what occurs when these transferred assets take on new meanings from its original context, which in the context of the thesis lies in national institutions, Japan and Denmark (Dimaggio & Powell, 1983, p. 152). Dimaggio and Powell (1983) identifies the three mechanisms, coercive, mimetic, and normative, however, for the purpose of investigating the considerations in moving a TWC project into a Danish context the thesis will make use of institutional isomorphism in the sense that the three mechanisms are not empirically distinct to cover the institutional environments and systems (ibid.).

3.1.2 Recontextualization theory (Brannen, 2004)

"Context" is a term derived from Latin, meaning "to knit together", or "to make a connection", entailing the linking observations to a set of relevant facts, events of points of view that make possible research and theory form part of a larger whole (Rousseau & Fried, 2001). According to Brannen, 2004, contextualization is the process by which the hearer/transferee makes sense of his/her world, placing heavy emphasis on the cultural context of the transferor and transferee as the basis of the encoded and decoded meaning (Brannen, 2004).

The theory and practice of context and recontextualization was chosen as it is naturally positioned at the nexus of International Business (IB) studies. According to Brannen, the process of recontextualization relates to how transferred international assets take on new meanings in distinct cultural contexts as it is a process, which extracts text, signs, or meanings from its original context (decontextualization) and reuse it in another context (Brannen, 2004). Brannen's view on recontextualization explores the assessment of fit when MNC's transfer assets abroad when the headquarters greatly differs from the subsidiary, where new meanings can be created as a result of recontextualization "how transferred organizational assets, including the notion of foreignness, take on new meanings in distinct cultural contexts (ibid.). The recontextualization view is applied to understand the nature in moving TWC, from the Japanese context into the Danish context and the recontextualization aspects, which needs to be considered (ibid.). Changing the international context of TWC into the Danish context changes not just the region for the project but as Gummesson, 2006, explains: "change the context and the entity itself is different, it realizes another of its infinite potentialities. It becomes something different. Something more" (Gummesson, 2006).

Brannen studies the transmission and reception of recontextualization in relation to language and semiotics in a cultural context, meaning how language produces meaning in situated contexts (Brannen, 2004). This thesis will make use of Brannon's study on recontextualization in transferring TWC as a whole from the Japanese host environment to a Danish recipient environment in relation to institutions and national systems instead of language and semiotics, looking at the considerations, which are involved in transferring the TWC project from one context to another (ibid.).

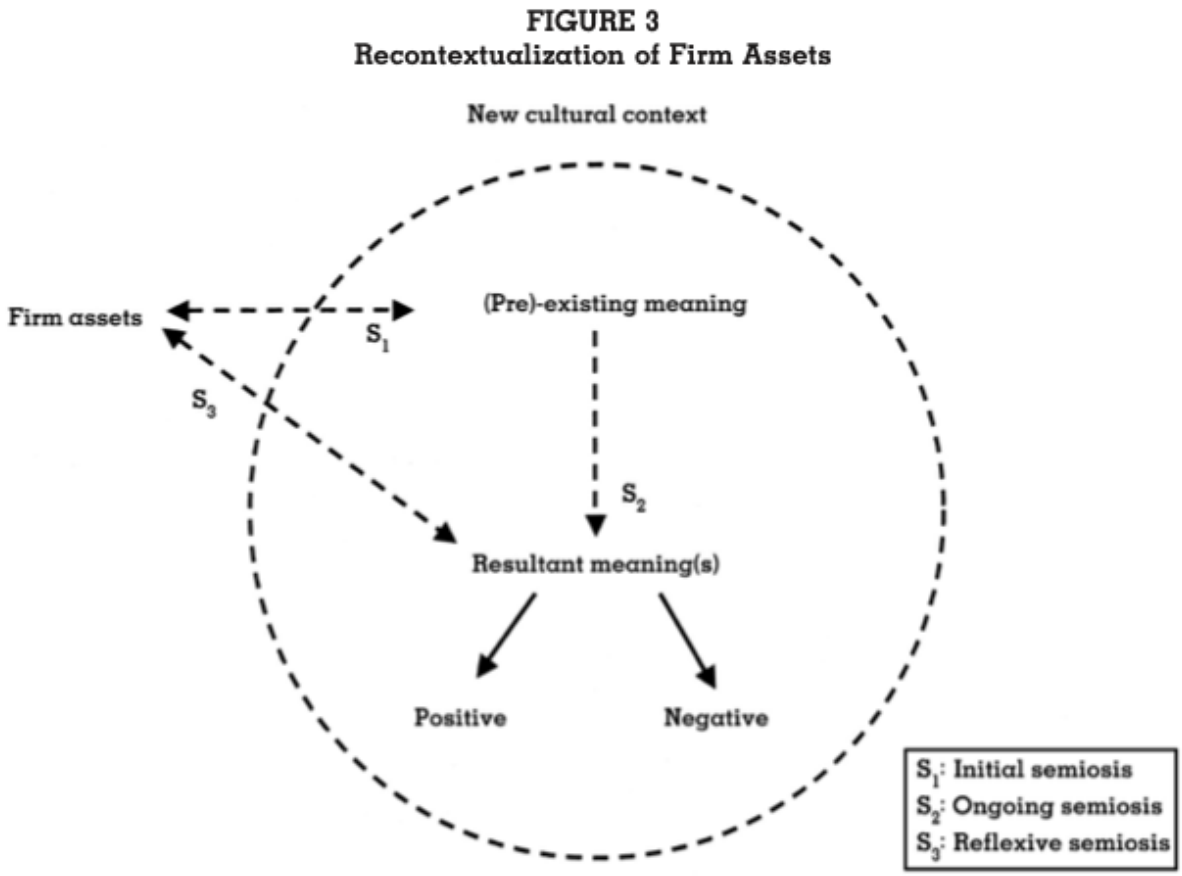


Figure 5. Recontextualization of Firm Assets. Source: Brannen (2004).

To this, Brannen has formalized a conceptual model of recontextualization, which shows the process of tracking the shifts in meanings attached to firm assets or in this case, TWC, as it moves from the Japanese context to the Danish, with "three key triggers of semiosis in transnational transfer": initial semiosis, ongoing semiosis, and reflexive semiosis (Brannen, 2004). As TWC is an on-going project and the thesis investigates transferring TWC to a Danish context, the thesis focuses on initial semiosis, where firm assets, TWC, are transferred into a Danish context that have some pre-existing knowledge of Japan and Toyota, due to internationalization, where the TWC project go through the Danish cultural sensemaking filters (ibid.). As new meanings can arise from recontextualization in the new context, semantic fit, or the lack of semantic fit, is "critical to successful internationalization and the transfer of assets abroad", which is highly dependent on how the recipient context understand the host context's transferred assets (ibid.). The meanings can result in positive recontextualization, which can be a source of competitive advantage and lead to innovation, whereas negative recontextualization poses a threat to successful transfer of assets (ibid.).

Brannen's recontextualization theory is highly relevant for the aim of this thesis, however, even though Brannen studies recontextualization in relation to language, Brannen's examples of recontextualization consisted mostly of non-language examples, such as sushi, Mickey Mouse, the little mermaid, and black kimonos, where only few language-specific examples were present, such as improvised jokes and dialects for Disney shows (Brannen, 2004). This aspect made it challenging for the researcher to fully understand the intention of usage of recontextualization in relation to TWC and the researcher therefore only make assumptions about the new meanings in TWC's adhered assets. Figure 6, visualized below, is a depiction of the considerations of moving TWC from a Japanese context to a Danish context regarding the four themes, by combining institutional isomorphism and recontextualization, which is later delimited by Clausen's multi-communication model in the supporting theory section:

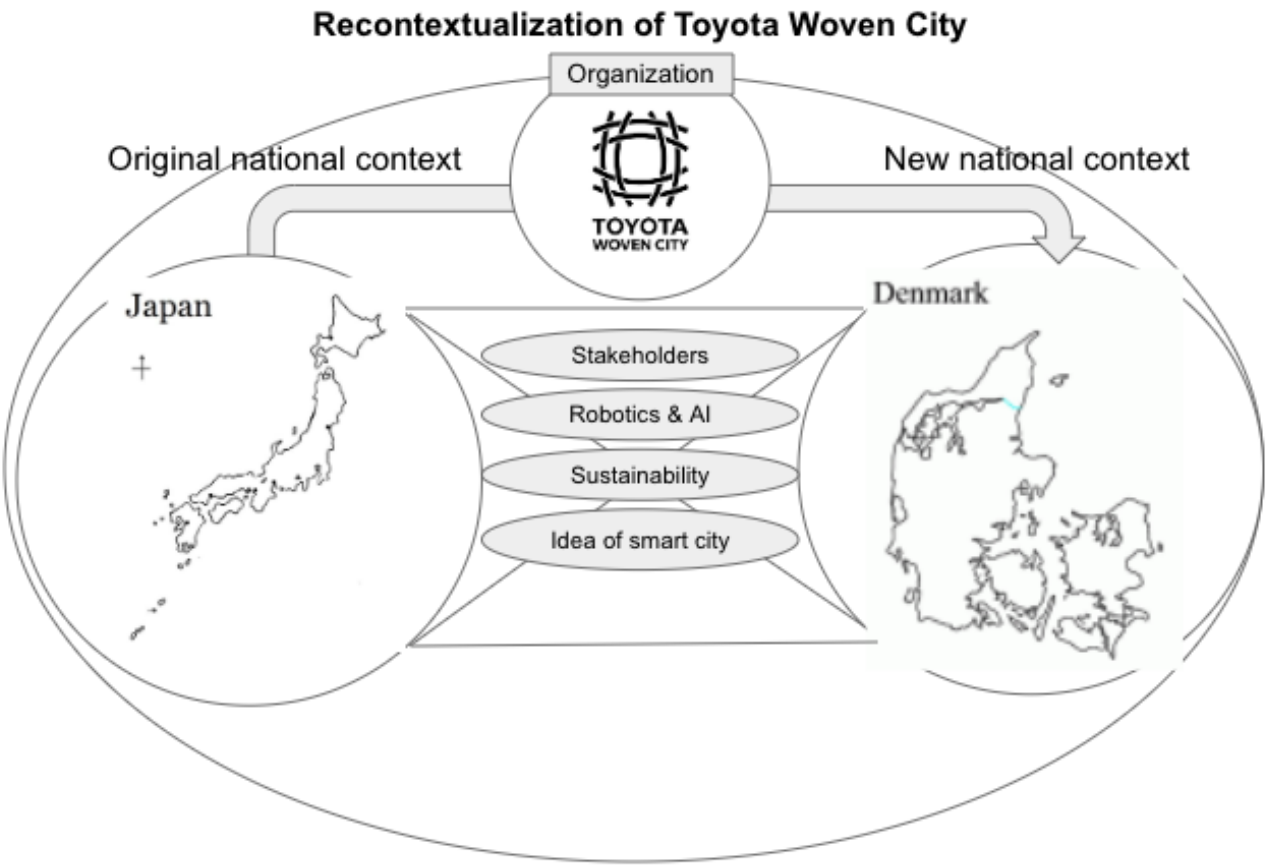


Figure 6. Own depiction (2022) of national recontextualization for a TWC project in Denmark, inspired by Brannen (2004) and Clausen (2006).

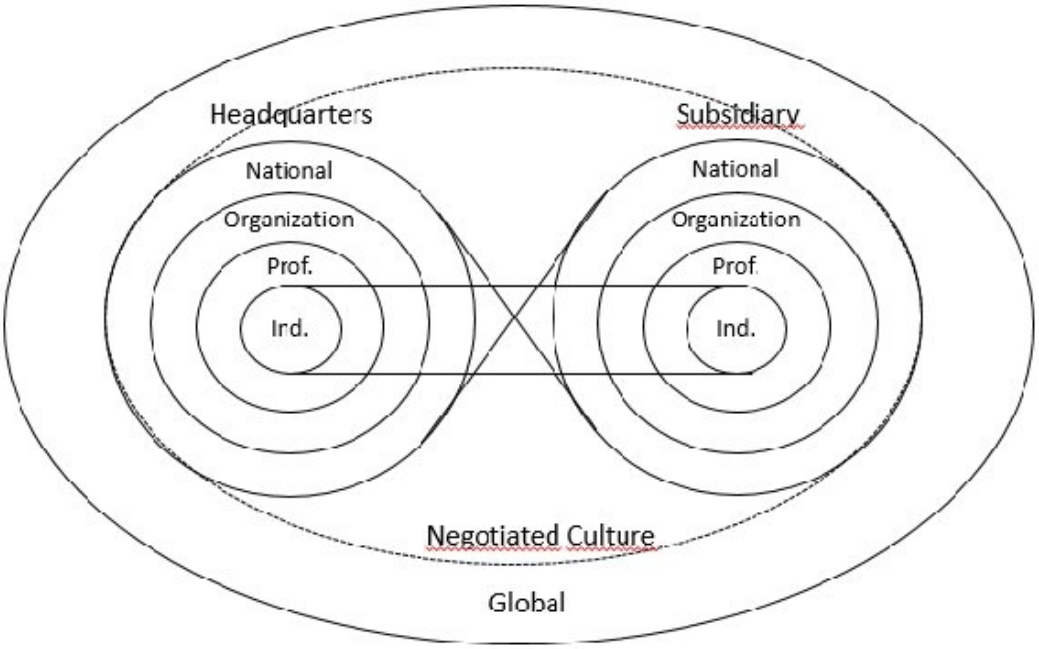
The model depicts four gray boxes, which are the four themes identified from expert interviews to contain relevant considerations when moving the TWC project into a Danish context. The

circles and lines were inspired by Clausen's model, where the largest circle resembles the global level, the two smaller circles resemble each of the national levels, and the lines connecting the national levels resemble the four themes changing, adapting, or staying the same according to the given context (Clausen, 2006). Clausen's model and its usage for the thesis will be further explained in the supportive theory section.

3.2 Supportive theory

3.2.1. Multi-Level Communication model (Clausen, 2006)

Clausen's (2006) multi-level communication model will be used to delimit Brannen's (2004) recontextualization to the levels used for analyzing the considerations of moving the TWC project from a Japanese host context, the headquarters, to a Danish recipient context, the subsidiary, by using the global level, is through to the organization level, which will be the delimitation for the thesis (Clausen, 2006).



Display 1. Source: The multi-level communication model, influences on managers in intercultural encounters: Global, national, organizational, professional, and individual models, Clausen (2006).

Clausen's multi-level communication model includes global, national, organizational, professional, and individual levels (Clausen, 2006, p. 63). The model was originally used to analyze communication between global managers in Danish HQ's and their Japanese

subsidiaries with a step-by-step approach from the global level through to the professional and individual level (ibid.). For the aim of this thesis, TWC will be analyzed as an organization in relation to which considerations lie in the isomorphism and recontextualization of TWC's (company) assets to a Danish context from a global level through to the organizational level, thus, omitting the professional and individual level (ibid.).

The thesis will utilize Clausen's model to delimit recontextualization to the global through to the organization level of the TWC project, with a focus on the national level, in relation to moving it from a Japanese host context to a Danish recipient context. The global level will in this thesis be referred to as the "international" level with the interview subjects placed in the model according to national expertise; Aikawa in the Japanese context, Jensen, Jacobson, Elcer, Craggs, Axelsen, and Nielsen in the Danish context, and Nakajima going across both contexts due to his background in the Danish Embassy and Mitsubishi UFJ Research and Consulting (Nakajima, Appendix 8). The mapping of the interview subjects in Clausen's multi-communication model can be visualized in appendix 17. The international (global) level concerns the international strategy and its local implementation, which internationally varies from one nation to another as the national level's primary concern lies within business system organization and national culture and its local differences, which influence strategy formation (Clausen, 2006). The models view nations in an international context, where the organizational level is resembled by the investigated TWC project in Japan (ibid.). A holistic view of Clausen's multi-communication model could have been created to include all levels. However, as TWC is still being developed and the limited access to data gathering corresponding to the two last levels, the professional and individual levels were omitted and the research question of investigating considerations in relation to moving the TWC project to a Danish context was analyzed using the expert interviews

3.2.2 Identification of stakeholders of a smart city development project (Jayasena et al., 2019)

Stakeholder management is a core activity for creating project success, where project stakeholder management includes stakeholder identification, classification, communication, engagement, empowerment, and risk control (Jayasena et al., 2019). When developing a smart city, challenges arise, which can be associated with having multiple diverse stakeholders, high levels of interdependence, competing values, and social and political complexity, which states

the importance of including elements of stakeholder management for smart city projects (ibid.). Stakeholder management is key in initiating smart cities, which is to create a sustainable and human-centered live-able city (ibid.). The stakeholders of a smart city project can help achieve the goal of implementation of smart cities and therefore it is important to gain an understanding and identify the stakeholders who may contribute or influence the project (Jayasena et al., 2019).

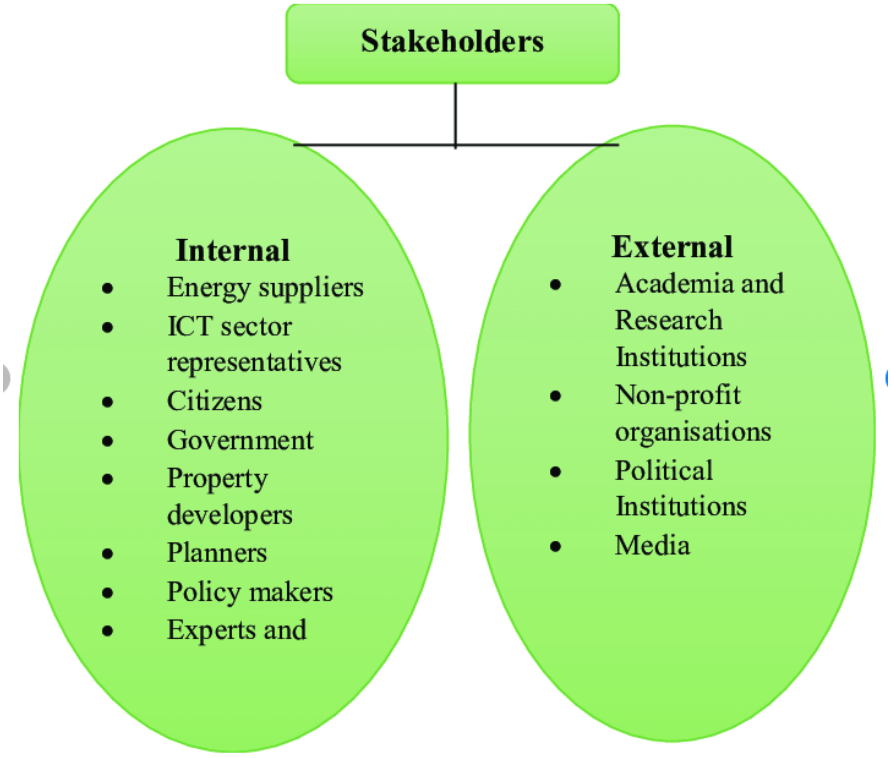


Figure 7. Stakeholders of a smart city project. Source: Jayasena et al., 2019.

Jayasena et al. identifies internal stakeholders as stakeholders who were interested in the financial activities and efficiency who could directly influence or be directly influenced whereas external stakeholders were identified as stakeholders interested in the value and quality who could indirectly influence or be indirectly influenced (Jayasena et al., 2019). The internal stakeholders involve *energy suppliers* as sustainability is important and thus, sustainable energy supply is required for the operation of the smart city (ibid.). *ICT* (Information and Communications Technology*) sector representatives* are important as technological factors are essential requirements and thus, contributing the development of a smart city (ibid.). *Citizens* were identified as a main type of stakeholders as they experience urban space and report inefficiencies or their views on the smart city whereas *Government* is responsible for knowledge creation and capitalization, making it an important stakeholder for

the smart city concept (ibid.). *Property developers* are important to identify as smart cities are often driven by conflicting interests of property developers who are interested in innovation and technological advancements whereas *planners* should be identified since sustainable urban development is considered a key planning goal where the smart city concept is a solution to achieving it (ibid.). In policy making, achieving sustainable urban development is a key goal where *policy makers* are important to identify as they are interested in making policies which leads a city to be smart (ibid.). Lastly for internal stakeholders, *experts and scientists* are important to identify as they are important for the innovation processes in a smart city (ibid.).

The external stakeholders involve *academia and research institutions*, which are important in planning and development strategies for a smart city as they contribute for the initiation of smart cities through academic research (Jayasena et al., 2019). Significant project-to-project learning processes in each stage of a smart city are important for *non-profit organizations* and social institutions and the results which arise due to the implementation of a smart city (ibid.). *Political institutions* and their engagement are important to identify since sharing of their experiences is an asset to a smart city project and can impact the governance of a smart city (ibid.). Lastly, media can influence a smart city project positively or negatively through the coverage of problems or advantages of a smart city (ibid.). Jayasena et al.'s (2019) identification of stakeholders for a smart city development project will be used to begin the analysis by identifying the stakeholders for TWC in Japan and continue to identify possible stakeholders for a TWC project in Denmark to then map the stakeholders, follow Mendelow's Power-Interest grid, which are important for a smart city development project.

3.2.3 Stakeholder mapping for a smart city project (Mendelow, 1991)

After the identification of stakeholders follow the approach from Jayasena et al. (2019), the thesis will continue to map the stakeholders following the approach from Mendelow, 1991. Mendelow suggests mapping stakeholder groups using a power and interest grid, visualized below in figure 8 (Mendelow, 1991). According to Mendelow, stakeholders may be positioned on a matrix whose axes are power held (the ability for the stakeholder to disrupt the activities of the organization) and the likely level of interest from the stakeholder in the organization's activities (ibid.). The factors will help the placement of the stakeholder in the matrix and thus, define the type of relationship the smart city should seek with its stakeholders (ibid.).

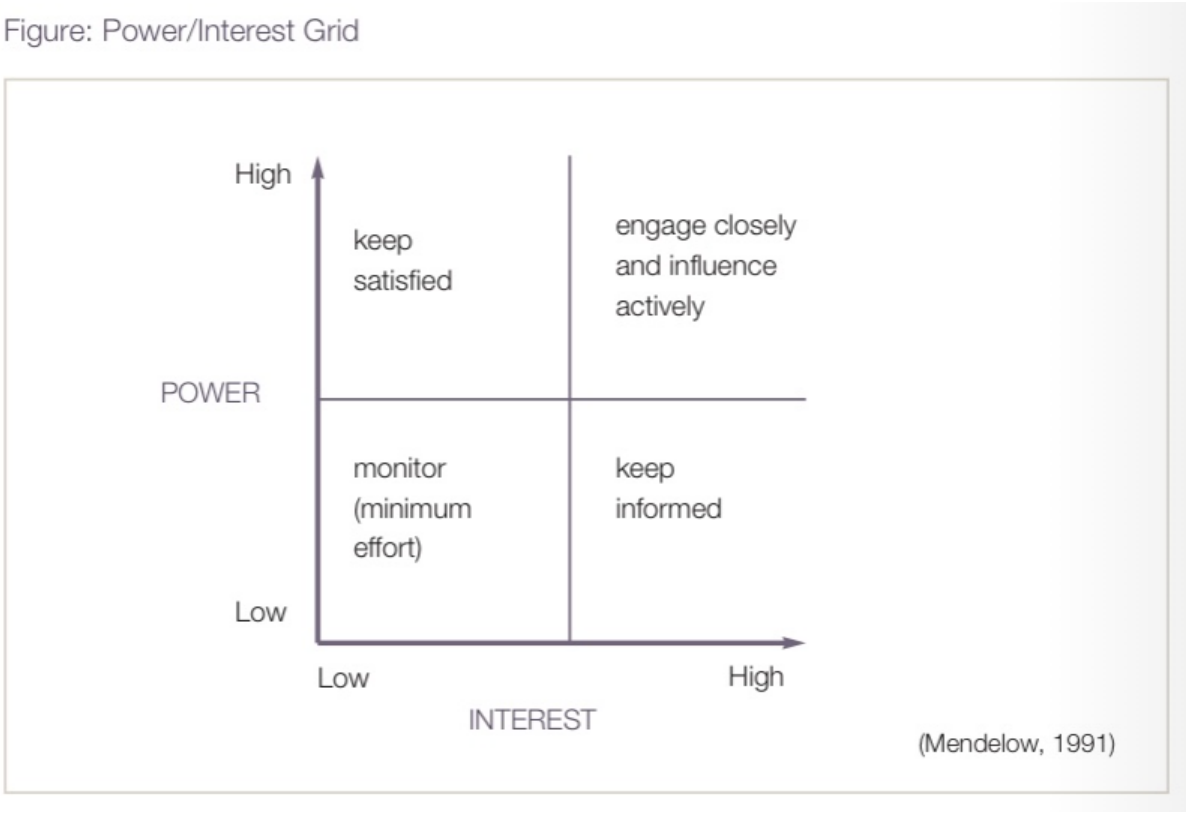


Figure 8. Stakeholder Mapping. Power/Interest Grid. Source: Mendelow, 1991.

Creating a stakeholder map is a way to visualize all the external and internal influencers on the smart city project where Mendelow's matrix categorizes the stakeholders into four boxes Mendelow, 1991). 1st quadrant: high interest and high power, which are key players who should be monitored closely, ensured they are fully engaged, involved in the decision making, and influenced actively, 2nd quadrant: high interest and low power, which is a group with low influence but should be kept well-informed of changes and their opinions heard, 3rd quadrant: low interest and high power, which is a group with low interest in the project but should be kept satisfied should they move to the high interest and high power quadrant, and the last 4th quadrant: low interest and low power, which is a group that do not have the influence to impact the project and are not interested in doing so, which creates no need to engage them or inform but simply monitored in case their status changes (ibid). Due to the unfinished status of the TWC project, this thesis will include stakeholder identification and mapping (classification) using a matrix developed from Mendelow, 1991, for both TWC in Japan and a potential version for the Danish landscape.

3.2.4 Hofstede's Cultural Dimensions (1983)

Hofstede's cultural dimensions are applied in the analysis, with a special focus on the *power distance* and *uncertainty avoidance* dimensions, to investigate TWC, as culture is defined by Hofstede as "the collective mental programming of human minds, which distinguishes one group from another (Hofstede, 1983). Hofstede operationalizes national culture into a paradigm consisting of six dimensions: 1. *power distance*, 2. *uncertainty avoidance*, 3. *individualism vs. collectivism,* 4. *masculinity vs. femininity*, 5. *short-term vs. long-term orientation*, and 6. *restraint vs. indulgence* (Hofstede Insights, 2022).

The power distance dimension entails the way society copes with inequalities and the attitude in the culture towards the inequalities among its citizens (Hofstede Insights, 2022). The power distance dimension is applied in the stakeholder analysis to investigate the choice of stakeholders to be involved in a TWC project in Denmark by underlining the variations in Japanese and Danish business culture and the choice of a PPP-model for Denmark with the interview subject's statements. The uncertainty avoidance dimension entails the extent to how the members of the given culture feel threatened by unknown situations and have created institutions and beliefs as an effort to avoid the situations (ibid.). The uncertainty avoidance dimension will be applied to the robotics and AI section in relation to digital trust to explain Nakajima's statement regarding the Japanese valuing the feeling of safety, which can be misunderstood as trust (Nakajima, Appendix 8). The dimensions are used supplementary to the main theories to investigate the underlying culture varying from the two national cultures, Japan and Denmark.

4. The concept of smart cities and Toyota Woven City

This section will cover the concept and definition of smart cities, benchmark TWC to current multi-generational or futuristic living places in Denmark, and lastly touch upon the types of smart cities located around the world.

4.1 The concept of smart cities

The "smart city" concept is increasingly becoming an important term in urban development models and city discussions (Jayasena et al., 2019). It is still difficult to find one precise definition of a smart city as there is no unanimous definition used. Definitions include the European Commission's definition: "a smart city is a place where traditional networks and

services are made more efficient with the use of digital solutions for the benefit of its inhabitants and business. A smart city goes beyond the use of digital technologies for better resource use and less emissions. It means smarter urban transport networks, upgraded water supply and waste disposal facilities and more efficient ways to light and heat buildings. It means a more interactive and responsible city administration, safer public spaces and meeting the needs of an ageing population" (European Commission, 2022). Additionally, the Department of Business, Innovation, and Skills, UK 2023, explain that "the concept is not static, there is no absolute definition of a smart city, no end point, but rather a process, a series of steps, by which cities become more "liveable" and resilient and, hence, able to respond more quickly to new challenges" (IGBC, 2022.). Jensen explained that "if you boil it down, what is it then that makes a smart city smart? It is that you manage to bring new technologies into play, which then creates some good business models but also create a city and a life that is good to be in" (Jensen, Appendix 2, p. 11). Jacobson, architect in BIG, explained that "all smart city really means is that there is information available about what's going on and the planning can get better" (Jacobson, Appendix 3, p. 23).

Although there is no unanimous definition or universal model of smart cities, the definition from the European Commission and Jensen will be used in the thesis. It is possible to understand the smart city mechanisms through 6 key dimensions, which also answers the question: what makes a city smart? In their concept of a smart city, Giffinger et al. (2007) identified six dimensions for assessing a city's performance as a smart city; *Smart Economy, Smart People, Smart Governance, Smart Mobility, Smart Environmen*t, and *Smart Living* (Appendix 10). Giffinger et al. explain that the six characteristics have assigned factors. Smart economy includes factors around economic competition like innovative spirit, entrepreneurship, economic imagine & trademarks, productivity, flexibility of labor market, and the integration in the (inter-)national market (Giffinger et al., 2007). Smart people include the level of qualification or education of the citizens, affinity to lifelong learning, flexibility, creativity, open-mindedness, social and ethnic plurality, and participation in public life and smart governance includes political participation in decision-making, public and social services for citizens, transparent governance, and the functioning of the administration (ibid.). Smart mobility includes local and international accessibility, the availability of information and communication technologies (ICT[5]-infrastructure), and innovative, sustainable, and safe

[5] From here on out referred to "ICT".

transport systems (ibid.). Smart environment includes attractive natural conditions (climate, green space, etc.), pollution, sustainable resource management, and efforts toward environmental protection (ibid). Lastly, smart living includes aspects of quality of life, such as cultural facilities, health conditions, individual safety, housing quality, education facilities, touristic attractivity, and social cohesion (ibid.).

It poses the question whether a smart city needs to embrace all dimensions. An approach which covers all six key indicators is regarded as a holistic strategy towards becoming a smart city (Bee smart city, 2020). According to the interview subject Nakajima, then "ideally, a smart city needs to embrace all six dimensions. However, it is considered appropriate to take a step-by-step approach to realize the vision by viewing the six dimensions as a process" (Nakajima, Appendix 8, p. 75). The facilitation of smart collaboration and innovation between government, private sector businesses, academia and the citizens are of high importance where engaging and targeting all stakeholders within a municipality is a key driver for success in all six of the smart city indicators (Bee smart city, 2020).

4.2 Benchmarking and categorization of smart cities

This section will benchmark TWC to the type of similar multiple-generational and futuristic living places and/or institutions in Denmark. Benchmarking and categorization of smart cities have the purpose of comparing them to each other based on various constructs and factors (Anthopolous et al., 2016). Much like the definition of smart cities, the existing literature on benchmarking of smart cities all have various types of measurements to evaluate the smart city factors (ibid.).

As an example of new living-facilities in Denmark with various generations sharing space, Nielsen mentioned the Flyvestation in Værløse, which has been closed to build the new project "some of what they are building a lot of is cluster houses but it's like small collectives (kollektiver) where you have a common house (…) where you build on what was already there. There are not a lot of settlements to start with at an airport but there are some buildings, a small pond, and stuff like that. Then they have a shared house and shared dining, which is very popular" (Nielsen, Appendix 7, p. 58). The cluster houses in Flyvestation Værløse is becoming a modern residential area with focus on nature and the community, with the aim of great

diversity in the housing community built in the figure eight with cozy houses and a number of shared community activities in the middle (Reka Group, 2021).

Nielsen additionally mentioned the "generational house. KMB (…). They have been working on it for many years (…). I actually think they are in the process of building one or two of them in Copenhagen (…). Then there are both youth apartments, and there are family apartments, and apartments for elders (…) and at the same time, there are some common facilities and some cafés and shops where they have spent time on trying to develop how you can construct such an apartment complex as generational housing" (Nielsen, Appendix 7, p. 58). Almost one in every seventh Dane wishes to live in shared living-facilities, and with the growing urbanization and global phenomenon of an ageing population, it may increase the demand for living facilities with seniors (Appendix 14, Boligen, 2021). The shared living facilities in multi-generation households is a much more common practice in Japan, which is rarely seen in Denmark and the West, where three, four and sometimes five generations share a household since the expectation is that one of the children will come and live in the grandparent's house with their own family (Brown, 2022).

There is a growing number of cities which call themselves smart cities, which are being developed into smart cities from traditional, existing cities by implementing smart solutions, where some of the most recognized include Singapore, Dubai, Oslo, Boston, Amsterdam, New York, London, and Hong Kong (Kosowatz, 2020). Even in Denmark, smart city projects, created from existing cities, are continuously being developed in various cities with municipals collaborating with business and academia, such as Copenhagen, Århus, and Albertslund, which are recognized as showing great pursuit in smart city solutions (Doody et al., 2016). However, the smart city activities in Denmark are still on a smaller scale (ibid.). Most global smart cities are created from a conversion of existing cities as opposed to TWC where "they will have a clean slate, they can experiment that way" and "you can create the solutions from the start" (Jacobson, appendix 2, p. 23 & Axelsen, Appendix 6, p. 48). Few smart cities are created from a clean slate, such as TWC, however, a few smart cities built from the ground are in the process are being developed, such as "Telosa" in the US, which is to finish in 2030, and the Terminus project in Chongqing, China, which are both also designed by BIG (BIG, 2022). However, TWC will be used as the case study for the aim and context of the thesis as a "human-centered", "ever-evolving", "living laboratory" smart city of the future (Toyota Woven City, 2022).

5. Attitudes towards robotics and emerging technologies in Japan and Denmark

With the global increase in the usage and commercialization of robots in work as well as daily life, this section will investigate the cultural differences in perception and attitudes towards robots and emerging technology in Japan and Denmark, within Europe, to serve as a background understanding of the variations in cultural contexts before moving to the four-split analysis section.

5.1 Attitude towards robotics and emerging technology in Japan

Nomura Research Institute (NRI), a leading research think-tank in Japan, conducted a consumer survey in Japan, the U.S., and Germany (representing Europe) revolving around social acceptance of robots and artificial intelligence (AI) in terms of knowledge, social acceptance, and usage intention (Nitto et al., 2017). Nitto et al. (2017) classifies robots into three main groups; 1. utility robots with mechanical appearance (such as the robot vacuum cleaner "Roomba" or the voice-activated speaker robot "Alexa"), 2. social robots with the ability to communicate with humans but not humanoid robots (no human-like appearance, such as "PARO" the robotic seal), and 3. social robots with the ability to communicate with robots but with human-like appearance (such as "Pepper") (ibid.). Many of the robots within category three are manufactured by Japanese companies and the category consists almost entirely of Japanese products whereas American and European manufacturers have taken the lead in the development of the robots in category two (Nitto et al., 2017).

From the report, the Japanese respondents had a high level of familiarity with robots and associated the term "robots" with "humanoid robots", which are robots that can communicate with humans (Nitto et al., 2017). The study showed a generally positive attitude towards robots from the Japanese consumers. Most Japanese people have grown up watching anime's with robotics involved, such as *Astro Boy* (or *Mighty Atom 鉄腕アトム,* in Japan, which premiered in TV in 1963) or *Doraemon – Gadget Cat from the Future* (*ドラえもん*, which premiered in TV in 1973), which shows the Japanese tendency to define a robot as a partner having a human-like appearance and robots living together with humans (ibid.). *Doraemon* is an animated male, time-traveling robotic cat that became an ambassador of technology, creativity, and innovation in Japan post World War II (ibid.). WWII was not just a war between humans but a battle of humans against technology, which has resulted in what Nakajima elaborates as "the Japanese

attitude toward robots, new technologies, and smart cities is that many people believe that technology will open up a new future" (Nakajima, Appendix 8, p. 76). The Japanese perspective of robots is derived from as early as the early Edo period (from year 1603 to 1867) with performances of mechanized *karakuri* puppets (からくり人形), where Japan is nowadays assumed to be the robot nation of the world (Haring et al., 2014). As Nakajima succinctly explains "in the case of Japan, the country has grown through technological development, and a somewhat technology-oriented mindset has permeated the country" (Nakajima, Appendix 8, p. 76).

When looking into consumer's intention to use new technologies, with the example of self-driving cars like in TWC, Japan scored higher with 41 percent stating "somewhat want to use" whereas Germany (representing Europe) scored lower with 30 percent (Appendix 11, Nitto et al., 2017). Overall, from the survey, the willingness to use or accept technologies had a high percentage of intention from Japanese consumers whereas the proportion of German respondents, who were not willing were higher, representing the European market (Appendix 11, Nitto et al., 2017).

5.2 Attitudes towards robotics and emerging technology in Denmark

In the Nomura Research Institute survey, Germany resembled the European market, which showed a strong tendency to consider robots for industrial purposes where people felt a strong resistance towards the presence of robots in their households (Nitto et al., 2017). In Europe, consumers showed a strong tendency to define robots as emotionless and faithful industrial robots (ibid.). Assumptions about robots from respondents from European countries involve robots as pragmatic assistants to be assigned for certain tasks at work or in households, rather than a human companion (Haring et al., 2014).

According to the 2019 Global Entrepreneurship Index, Denmark ranked number four in the world and number one in the European Union, scoring top on opportunity for start-ups, technology absorption, human capital, and competition, out of the 14 pillars countries are scored on of a healthy entrepreneurship ecosystem (Copenhagen Capacity, 2020). It is further explained as: "Denmark offers one of the world's most dynamic and attractive environments for business. Denmark is one of the most digital countries in the world, it has an ambitious climate agenda, it is a great place for entrepreneurs, and Copenhagen is ranked one of the best

places to live" (ibid.). Additionally, Denmark ranked 4th in Cisco's Global Digital Readiness Index (score: 18.98), only topped by Singapore (score: 20.26), Luxembourg (score: 19.54), and the United States (score: 19.03), which makes Denmark one of the world's top locations for tech-activities with state-of-the-art digital infrastructure and a world-class talent pool across tech areas (Innovation News Network, 2020).

The Ministry of Foreign Affairs of Denmark states that "Denmark is the world's best test market for robots and drones" since "Denmark hosts a range of test sites for drone and robot applications in healthcare, agriculture, and production, including opportunities for running tests with real end-users and in full-scale environments. That makes Denmark the easiest point of entry to the European market and a foothold in Denmark means a foothold in the vast EU market with 490 million consumers" (Invest in DK, 2022). Test sites include university test sites, such as SDU (Syddansk Universitet) and isolated test areas, such as "Doll Living Lab", which is an outdoor test-laboratory in Albertslund. The interview subject Jensen, Director of Invest in Denmark, adds that "Denmark has the best Research and Development environments. Whether you're a MedTech company creating new solutions, or you want to create digital solutions for senior citizen homes, Denmark is a very attractive place because the concentration is really big and universities are well funded by public and private research funds, which creates the most talented people to be in Denmark. So, if you want to make these types of solutions, then if you settle down here (in Denmark), you will have access to that talent pool" (Jensen, Appendix 2, p. 12).

The robotics industry in Denmark is geographically clustered specifically around the strong ecosystem on Fyn with strong growth in its entrepreneurial environment with 38 percent of Danish robotics companies being established after 2009 (Iris Group, 2019). The development has specifically been within collaborative industrial robots (cobots), which is the type of robots that include physically flexible robots to work with humans in a work setting (ibid.). Arguably, one of the most recognized robots in Denmark from Japan is the therapeutic robot seal, PARO, which is within the social robot category with the ability to communicate with humans but not humanoid robots (no human-like appearance) (Nitto et al., 2017). PARO is especially used as a therapeutic robot pet at nursing homes in Denmark as its technology enables it to respond to touch by creating sounds and creating movements (Iris Group, 2019).

6. Analysis

The following analysis section will examine the findings identified from the four themes earlier described, derived from the transcribed interviews, and the section will move through; 1. Investing in Denmark, 2. Sustainability, 3. Robotics & AI, and 4. The idea of a smart city in Denmark.

6.1 Investing in Denmark

It is important to identify the stakeholders for a smart city project as it is a core activity for creating project success (Jayasena et al., 2019). The first section of 1. Investing in Denmark will identify the published stakeholders for the TWC project in Japan and continue to map the stakeholder groups using a power and interest grid to position the stakeholders on a matrix in accordance with Mendelow's (1991) theory for mapping stakeholders. The second section will identify the possible stakeholders within the same categories for a TWC project in a Danish context where the section will continue to map the identified possible stakeholders in a Danish context in relation to the interview subject's statements (Mendelow, 1991).

6.1.1 Stakeholder identification and mapping

Generally, stakeholders and the management of the involved stakeholders in a smart city project differs from traditional city development where "in most cases, the beginning phase, of traditional city development, it involves an architect, a construction company, and a consulting company of the city design who will join in in the city development (Nakajima, Appendix 8, p. 71). With smart cities, like TWC in Japan, Nakajima further explains that there "is a big difference because Toyota doesn't need to involve these kinds of experts because this is an R&D city for Toyota (…). BIG is in charge. He is now designing the overview of the city management", which creates a difference for how the involved stakeholders in the TWC project are managed as fewer experts are involved in achieving the goal of the implementation of TWC (Jayasena et al., 2019, Nakajima, Appendix 8, p. 71).

6.1.1.1 Stakeholder analysis, TWC (Japan)

Table 2, visualized below, serves as an overview of the identified stakeholders for the TWC project in Japan. The identified stakeholders are limited to public announcements and information from the Toyota spokeswoman and global PR manager, Aikawa, within the given timeframe of the research project.

Identification of stakeholders for the TWC project:

Internal stakeholders	**External stakeholders**
Energy suppliers: ENEOS Corporation (ENEOS), Toyota ICT sector representatives: NTT Corporation (NTT), Apex.AI, Woven Planet Group Citizens: Toyota employees and families, retailers, scientists, industry partners Government: Susono (city), Shizuko (prefecture) Property developers: Bjarke Ingels Group (BIG), Woven Planet Holdings Planners: Mobility in Chain (MIC), Atelier Ten, Kaleidoscope Creative, Matternet, 2150 Policy Makers: Experts and scientists: Global experts and scientists visiting or living in TWC, Woven Planet Holdings	Academia & Research Institutions: Non-profit organizations: Political Institutions: Media: NTT Corporation, Toyota newsroom website, Japanese news forums, smart city news websites (such as SmartCity.Press, SmartCitiesWorld, and Smart Energy International), Squint Opera

Table 2. Depiction of published identified stakeholders for TWC Japan. Own depiction, 2022.

To drive TWC to become the most hydrogen-based society and fully carbon-neutral, Toyota has entered a partnership with the energy supplier ENEOS Corporation (ENEOS) (Toyota Newsroom, May 10, 2021). Toyota has invested in hydrogen and fuel cell technology with ENEOS as the core partner to validate TWC's hydrogen society and will conduct testing related to a hydrogen-based supply chain, from the production to the delivery to the usage of hydrogen in by leveraging on each other's expertise to explore the potential of hydrogen (ibid.).

The ICT sector representatives involve Nippon Telegraph and Telephone Corporation (NTT Corporation) with the aim of sharing technologies and knowledge in the usage and administering of Big Data from the autonomous vehicles to solve issues, such as traffic and congestion, by creating an ICT platform for connected cars for realizing a sustainable smart mobility society (Global Toyota, 2017). Additionally, the Woven Planet Group announced its

new vehicle software platform “Arene”, which can provide a real-time software platform, partnering with the company Apex.AI (Apex.AI, 2022). Concerning the citizens, one of the three principles for TWC is “living laboratory” where TWC will receive 2000 full-time residents, Toyota employees and their families, retired couples, retailers, international visiting scientists, researchers, and industry partners, who will continually test and develop technologies (Toyota Newsroom, Jan 7, 2020). As for the government, the location is identified as Susono City and the eastern Shizuoka prefecture in Japan at the foothills of Mt. Fuji, which is where the TWC project is being carried out (Toyota Woven City, 2022).

For the property developers, Toyota has commissioned the Danish architect team BIG for the design of the city (Toyota newsroom, 2020). Founder of BIG, Bjarke Ingels, explains that “we believe we have a unique opportunity to explore new forms of urbanity with the Woven City that could pave new paths for other cities to explore” (ibid.). Additionally, out of Toyota’s formerly known research institute “TRI-AD”, a newly formed subsidiary company has been developed, Woven Planet Holdings, comprising of three operating companies, 1. Woven Core to develop, implement, and scale automated driving technologies, 2. Woven Alpha to explore new business opportunities and innovative projects, and 3. Woven Capital to invest in growth-stage companies with innovative technologies and business models (Appendix 12, Jones, 2021). Woven Planet Holdings, and its three operating companies, acts not just as a property developer with interest in innovation and technological advancement in the property development of TWC but is also part of the internal experts and scientists by developing and exploring opportunities and projects (Jayasena et al., 2019).

The sustainable urban development planners involve the transport-planning and engineering company Mobility in Chain (MIC), which specializes in combining functional issues with an understanding of urban qualities and sustainability under the BIG team to develop innovative mobility strategies (MIC News stream, 2020). Woven Capital, the investment arm of the Woven Planet group, announced that it invested in the Climate Technology Sustainability Fund of the company 2150, a London and Copenhagen based venture capital firm, which invests in tech entrepreneurs and companies that strive to sustainably reimagine and reshape the urban environment for the future cities in 2150 (Toyota News, Oct 2021). Underneath the city, in an underground network, lies the infrastructure of TWC with a goods delivery system from the company “Matternet” using technologies, such as robotics and drones (BIG, 2022). Atelier Ten and Kaleidoscope Creative are also part of the team of planners where Atelier Ten is an

environmental and lightning design consultancy company to help create smart buildings and Kaleidoscope a company engaging in marketing campaigns Atelier Ten, 2022).

In addition to Woven Planet Holdings and its three operating companies as internal experts and scientists for TWC, the citizens include national and international researchers and scientists to develop technologies who also act as internal experts and scientists (Toyota Newsroom, Jan 7, 2020). For external media that can influence the TWC project, it involves the earlier mentioned NTT Corporation that, through the cooperative collaboration with Toyota, enables commercialization of smart city businesses and promote social development (Global Toyota, 2017). Various online news platforms were also included in the media stakeholders, such as Japanese news forums, Toyota's newsletters, and online newsroom, which was where most of the published stakeholders were identified. Various news websites focused on smart city news, insights, and development as well news forums, such as SmartCity.Press, SmartCitiesWorld, and Smart Energy International, which also provide a podcast series on the topic (Jones, 2021). Lastly, it was announced that the company Squint Opera is involved, which is a company specializing in communication of big ideas about cities through digital media (Squint Opera, 2022). This rounds up the identification of the published stakeholders for the TWC project to enable the mapping of the identified stakeholders according to importance. Figure 9, visualized below, serves as an overview of the identified stakeholders from the TWC project:

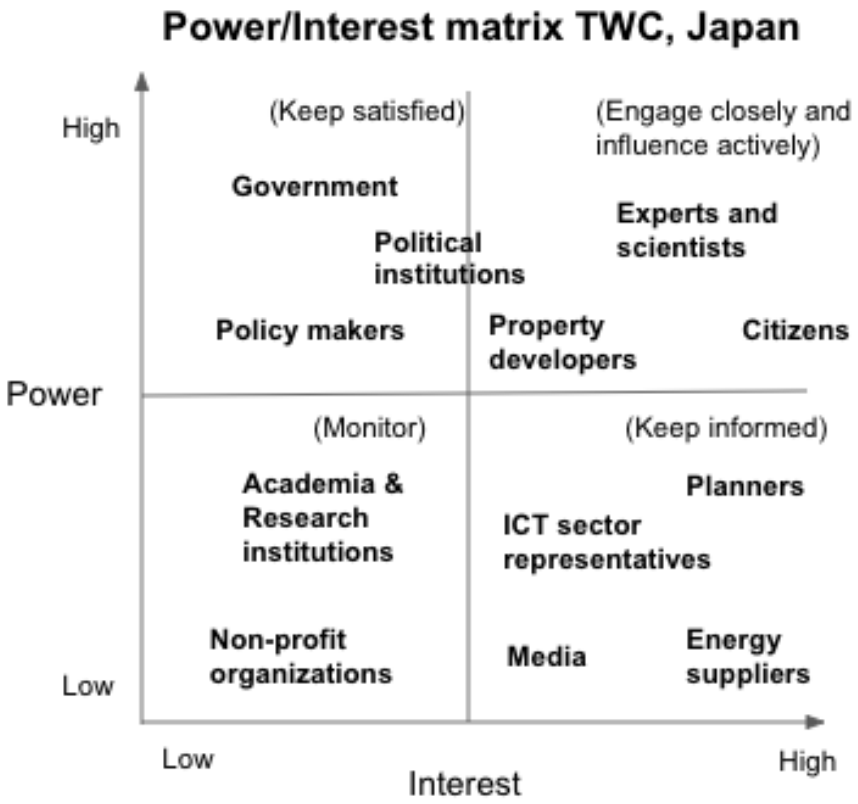


Figure 9. Depiction of identified stakeholders for TWC Japan mapped on a Power/Interest grid. Own depiction, 2022.

The stakeholders placed in the top right quadrant, the high-power and high-interest quadrant, includes the stakeholders where the TWC project has direct impact on a person or an organization as well as the stakeholders that have the ability to change, influence, or terminate the project altogether (Indeed, 2021). Following TWC's three principles; "human-centered", "living-laboratory", and "ever-evolving", the quadrant includes the citizens who hold high power and high interest in the city's development together with the experts & scientists who are also planned to populate the city during their visits (Toyota Newsroom, 2020). The citizens and researchers & experts play an important role to report inefficiencies and positive or negative views and knowledge on their experience of the new urban space and its smart technologies (Jayasena et al., 2019). Therefore, these stakeholders should be engaged with and satisfied fully along with the property developers who play an important part in the management of TWC (ibid.).

The ICT sector representatives' group is also important for the initiation of TWC through academic research, it is placed in the bottom right quadrant as the group has high interest but

low power since it cannot influence the TWC project directly (Indeed, 2021). The bottom right quadrant, which have some influence but can't change the project directly, is also populated by the planner, energy supplier, and media category, with the coverage of the development and advantages of TWC and its technologies but is not able to influence the TWC project directly (ibid.). The stakeholders placed in top left quadrant, the high-power and low-interest quadrant, involve the local community in Susono and the Shizuoka prefecture with its government, policy makers, and political institutions, which should be kept satisfied as the group is important and holds high-power but should not be communicated with as closely as the high-power and high-interest stakeholders (Indeed, 2021). Lastly, the bottom left quadrant holds the low-power and low-interest stakeholders, which involve potential customers for TWC with the academia and research institutions and the non-profit organizations group. These two categories are left unidentified and as TWC is a privately funded project, which places these types of stakeholders in the lowest priority category (ibid.).

6.1.1.2 Stakeholder analysis, Denmark

The TWC project in Japan is a privately owned project conducted by Toyota. Looking at the Danish context and the statements from the interview subjects, it is visible that the stakeholder analysis changes and the model changes meaning in a Danish context.

Nielsen argues that "the "OPP" collaboration (offentlig-privat partnerskab), a public-private partnership (PPP), is a really good idea" (Nielsen, Appendix 7, p. 62). With a background as director of the trade association Danske Tegl, Nielsen explains her statement saying that the incentive makes sense because it makes the builder commit to what he has built (ibid.). Nielsen continues with stating that "at the moment, Denmark is constructing inadequately in the sense that we have some constructors who build project apartments. We are building a lot of apartments at the moment. The constructors build them, they sell them right away, and then the constructor is gone. This means that, to the constructor, faults and shortcomings of the buildings are not really important since it is not his investment. After all, it is only the constructor's investment until he sells the apartment to you and me. If it was the contractor's own investment, the contractor would care more to build something that lasted a really long time or didn't need maintenance, so there's a financial incentive" (Nielsen, Appendix 7, p. 61). Nielsen proclaims that is where the PPP-models are to be made, the public-private partnerships, where those who construct also provide a guarantee for operation and maintenance, "so a

company like MT Højgaard would take the guarantee for 20 years for operation and maintenance of the building, which they handed over to the municipality. It gives MT Højgaard an incentive to make sure to construct buildings that the company doesn't constantly have to come and fix" (ibid.). By using a PPP-model there is a financial incentive for contractors to commit to the buildings they are constructing, which also creates the incentive to build better, smarter, and durable solutions for the future (ibid.). Jensen adds to Nielsen statement by explaining that "we should build on what we are good at in Denmark. We are good at the public-private partnerships (PPP) (Jensen, Appendix 2, p. 16). She continues by stating that if we are to succeed with creating a smart city in Denmark, it should be with a PPP stakeholder group "consisting of private companies, which have attractive products and could see, like a business model, that they could sell something, and municipal actors. These could be various classifications of municipal business development types, such as Invest in Denmark or Invest in other parts of the country, with the municipality leading the project since there is a lot of urban planning, regulations, and laws" (ibid.). Jensen explains that Denmark is adept in creating public-private partnerships because "Denmark is relatively transparent with no corruption and we are not very hierarchical as we are used to talking across authorities and companies. That would be the way forward" whereas Japanese business culture is much more formal "hierarchical and state-governed than Denmark" (Jensen, Appendix 2, p. 17). Following Hofstede's cultural dimensions, Japan scores as a borderline hierarchical country (54), making the Japanese conscious of their hierarchical position in any social setting and act accordingly, whereas Denmark is scored much lower (18) with decentralized power and informal and direct communication (Appendix 16, Hofstede, 1983).

The identified stakeholders for a TWC project in a Danish context were derived from the interview subjects' statements and published announcements from industry experts or companies involved in smart city management. Table 3, visualized below, serves as an overview of the identified stakeholders from interviews and online sources for a recontextualized TWC project in the Danish landscape making the identification non-exhaustive:

Internal stakeholders	External stakeholders
Energy suppliers: Vestas, Green Hydrogen Systems, Tokyo Gas Co Ltd & EWII ICT sector representatives: MT Højgaard, NCC, HD Lab Citizens: Government: Odense/local municipality, By- og kulturforvaltninger Property developers: Bjarke Ingels Group (BIG), Henning Larsen, Teradyne, robot cluster in Odense Planners: Holo, We Build Denmark, NaviAir, Urban Air Mobility (UAM), Rambøll Policy makers: Experts and scientists: Odense Robotics, Invest in Denmark, Space10	Academia and Research Institutions: SDU, DTU, AAU, other relevant universities, OUH, Doll Living Lab Non-profit organizations: Copenhagen Institute for Future Studies, Nordisk fond for miljø og udvikling, Green Building Councel Denmark, KL and Gate 21 Political institutions: Media: Space10, universities, robot, sustainability, and smart city news websites (such as eu-robotics.net, smartcities.au.dk, danskenergi.dk)

Table 3. Depiction of the identified stakeholders for a TWC project in Denmark. Own depiction, 2022.

The energy suppliers for a Danish TWC project play a key role for the operation of the smart city, which will be further elaborated later in the sustainability aspect of the analysis (Jayasena et al., 2019). Director of Invest in Odense, Joost Nijhoff, who provided access to the interview subject Elcer, shared insight on his LinkedIn regarding Vestas Offshore Wind expanding its Lindø factory in Denmark to the Port of Odense to increase the production capacity and create a giant C236-15.0 MW nacelles offshore turbine (called Blue Marlin) with production planned to start in 2024 (Kristensen, 2022). According to Vestas, the Blue Marlin windmill will be able to produce 80 gigawatt hours of electricity per year, which translates to enough energy to supply 20,000 households with electricity (ibid.). Additionally, Power-to-X (PtX[6]) was a term,

[6] From here on out referred to as "PtX".

which was touched upon by both Jensen. And Craggs (Appendix 2, p. 12, Appendix 5, p. 37). PtX is defined as a process where green electricity is converted to hydrogen or other PtX hydrogen-based products (Dansk Energi, 2022). To this, Green Hydrogen Systems is identified as a potential energy stakeholder as the company is striving to become a lead actor in the production of green hydrogen and global sustainability and has thus, recently inaugurated a new facility in Kolding where the production capacity will be a at least 400 MW (Tornbjerg, 2022). Additionally, announced on the Embassy of Denmark in Japan and Invest in Denmark's LinkedIn, Tokyo Gas Asia Pte. Ltd. has created a joint development subsidiary, TG Nordic, with the Danish energy company EWII Production A/S to develop renewable energy in Denmark and expand the scope to other Nordic countries with the aim of reducing the Danish CO2 emissions to 70 percent of their 1990 levels by 2030 (Power Technology, 2022). TG Nordic is a plausible prospect, along with Vestas and Green Hydrogen Systems, to power a TWC project in a Danish context. The identified stakeholders for the choice of green hydrogen are similar to how TWC in Japan will be powered, however, where TWC's green hydrogen will be supplied with solar energy and geothermal energy, green hydrogen for a TWC project in Denmark will be supplied with wind energy (BIG, 2022). The reasoning behind the choice of wind energy and green hydrogen as sustainable energy suppliers in TWC Denmark was derived from the interview subjects' expertise and will be further explored in the sustainability section of the analysis.

The ICT sector representatives were mainly derived from the interview subject Nielsen, the director of Danske Tegl, which was identified to include MT Højgaard, NCC, and HD Lab (Nielsen, Appendix 7). MT Højgaard is one of the leading building and construction companies in the Nordics with the development and construction of buildings and has "made something called VDC, Virtual Design and Construction, which I was a bit involved in" (Nielsen, Appendix 7, p. 59). VDC is a type of technology, which involves performance models of design construction including the product, work processes, and organization of the design, which will be further explained in the robotics & AI section of the analysis (MTHøjgaard, 2022). To this, the Swedish company, NCC, was mentioned, with its digital tools and solutions for their construction projects, as the company also uses VDC (NCC, 2022). Additionally, Nielsen mentioned Niels Falck from HD Lab, which is an ICT company that aids firms in the construction industry with the use of technology and Falck "was also involved with the "VDC" with MT Højgaard with the whole program as a main driver" (Nielsen, Appendix 7, p. 63).

The citizen's category has been left open for a TWC project in a Danish context. The citizens will depend on the location of the city, which will be discussed in greater detail in the subsequent discussion section. The aspect also concerns the government group, policy makers, and political institutions, which is identified to be the local municipalities, city, and cultural administration groups in the involved area, which were groups also left open for TWC in Japan. The property developers for a TWC project in a Danish context, which are interested in the innovation and property development of the smart city, involve BIG, Henning Larsen, and Teradyne (Jayasena et al., 2019). Jacobson, the architect from BIG, explains that he "would be shocked if we were not interested" in being part of creating a TWC smart city project in a Danish context (Jacobson, Appendix 3, p. 26). BIG is the primary stakeholder in the creation of the TWC project in Japan, which would then also be a primary stakeholder for a TWC project in the Danish context. Henning Larsen is also a Danish urban and landscape architecture firm, mentioned by Jensen, however, thus far, Henning Larsen has yet to be involved in a smart city project or a project located in Japan but has projects in other parts of Asia, such as South Korea, China, and the Philippines (Henning Larsen, 2022, Appendix 2, p. 16). To aid BIG or Henning Larsen, the American company, Teradyne, which designs and produces automatic test equipment (ATE) was identified as a possible stakeholder for a TWC project in Denmark (Digital Hub Denmark, 2020). Teradyne has already invested in Danish robotic firms, such as Universal Robots and Mobile Industrial Robots (MIR), as well as created a 36 mil. dollar investment in the initiation of a global center for collaborative robots in Denmark (ibid). The CEO and president of Teradyne, Mark Jagiela, has earlier expressed that Teryadyne has "found something extraordinary in Denmark" with the approximately 130 company robot cluster in Odense, which makes Teradyne a large, possible investor for a TWC project in Denmark (ibid.).

Concerning identifying urban planning firms, Rambøll is the second largest engineering consulting firm in the Nordics and announced in March that the company will partner with the 3D planning- and design-platform for smart cities, VU.CITY, to further contribute to the development of sustainable cities and communities for people to live in (Rambøll, 2022). Additionally, We Build Denmark is an organization, which acts as a cluster for the construction industry, companies, knowledge institutions, and public institutions concerning sustainable and digital technologies for future development of cities, smart cities and communities, innovation, business development, and internationalization (Axelsen, Appendix 6, p. 4, We Build Denmark, 2022). The cluster covers Gate 21 and Doll Living Lab, which is also identified as

potential investors in the following external category (ibid.). Craggs mentions NaviAir and Urban Air Mobility (UAM) explaining that "In Odense, we are specifically looking at getting Urban Air Mobility up and running, which is the possibility of entering drones into the city (…) There is a very close collaboration with Naviair, which is responsible for the Danish aviation management and the Ministry of Transport, testing drone flights at the airport" (Craggs, Appendix 5, p. 35). Additionally, for autonomous ground mobility company, Holo, is the current leading implementer and operator of autonomous vehicles in the Nordics with especially driverless buss projects in Slagelse, Aalborg, Nordhavn, Køge as well as in Norway, Sweden, Finland, and Estonia (Holo, 2022).

The identified experts & scientists will consist of Odense Robotics, Invest in Denmark, and other Invest in parts of Denmark depending on the location, which were mentioned by Jensen and Elcer, as well as Space10, mentioned by Jacobson, which is "a gallery and it's kind of an innovation workplace in Kødbyen (Appendix 2, p. 16, Appendix 3, p. 26, Appendix 5, p. 34). "Space10 hosts a lot of lectures on what the future might look like with experimenting" which makes Space10 also fall under the media and academia and research institution categories (Jacobson, Appendix 3, p. 27). The academia & research institutions is identified to include universities, such as DTU (Danmarks Tekniske Universitet), SDU (Syddansk Universitet), Aalborg Universitet (AAU), and other technical, robotic, and research-oriented faculties with "areas where they test technologies with a special focus on research and development of for example robotics" (Elcer, Appendix 4, p. 33). Attracting investors for a project in the Danish context is highly dependent on the large concentration of "universities which are really well funded by public research funds but also private funds, which means that the most talented people in the areas are located in Denmark (…). If you settle down here then you have access to that talent pool" (Jensen, Appendix 2, p. 12). Jensen explains that the concentration of talent from universities creates "an ecosystem of some actors who together make critical mass, which means that here you can really make a difference" because "Denmark has built a smart ecosystem, which consists of some universities, some companies, and then some start-ups that do spin-offs, so they can say, well, this PhD researcher who has done this, could then get some funding to make some business ideas", which makes this category very important for the implementation of a TWC project in Denmark (ibid.).

Doll Living Lab was identified as a possible research institution as it is "a vibrant urban environment in Albertslund municipality with approximately 13 km of road and path sections (…) that together with business partners build solutions in the scale 1 to 1, a living environment, and we have about 50 of them now. We have a lot of building blocks in the "lab" here" (Axelsen, Appendix 6, p. 42). Doll Living Lab's approach has similarities to TWC in Japan, with the "ever-evolving" approach, *kaizen*, which Toyota implements where new technologies and services continuously grow and improve (Toyota Woven City, 2022). However, Doll Living Lab is a smaller scale project, does not include citizens, and works with new companies for each project in developing new technologies (Axelsen, Appendix 6). Aikawa explains that *kaizen* (continuous improvement) is part of the Toyota Way's 14 principles and "the idea of Woven City being ever-evolving is reflecting in these areas as well" (Aikawa, Appendix 1, p. 7).

The non-profit organizations were identified to involve the Copenhagen Institute for Future Studies, the Nordic Development Fund (NDF), the Innovation Fund Denmark, the Energy Technology Development and Demonstration Program (EUDP), as well as Green Building Council Denmark, which Nielsen has been part of, as well as KL and Gate 21 that work with smart city activities in joint municipal and joint public digitalization efforts (Axelsen, Appendix 6, p. 42, Gate 21, 2022). Lastly, actors in the media category were identified as universities and Space10 previously mentioned as well as online news forums and websites on robotics, sustainability, and smart cities in Danish and European contexts, such as eu-robotics.net, smartcities.au.dk, and Danskenergi.dk. With this, the section of possible identified stakeholders for a TWC project in Denmark is concluded, which will be used in the following part where the identified stakeholders will be mapped according to importance. Figure 10, visualized below, serves as an overview of the identified stakeholders for a potential TWC project in a Danish context:

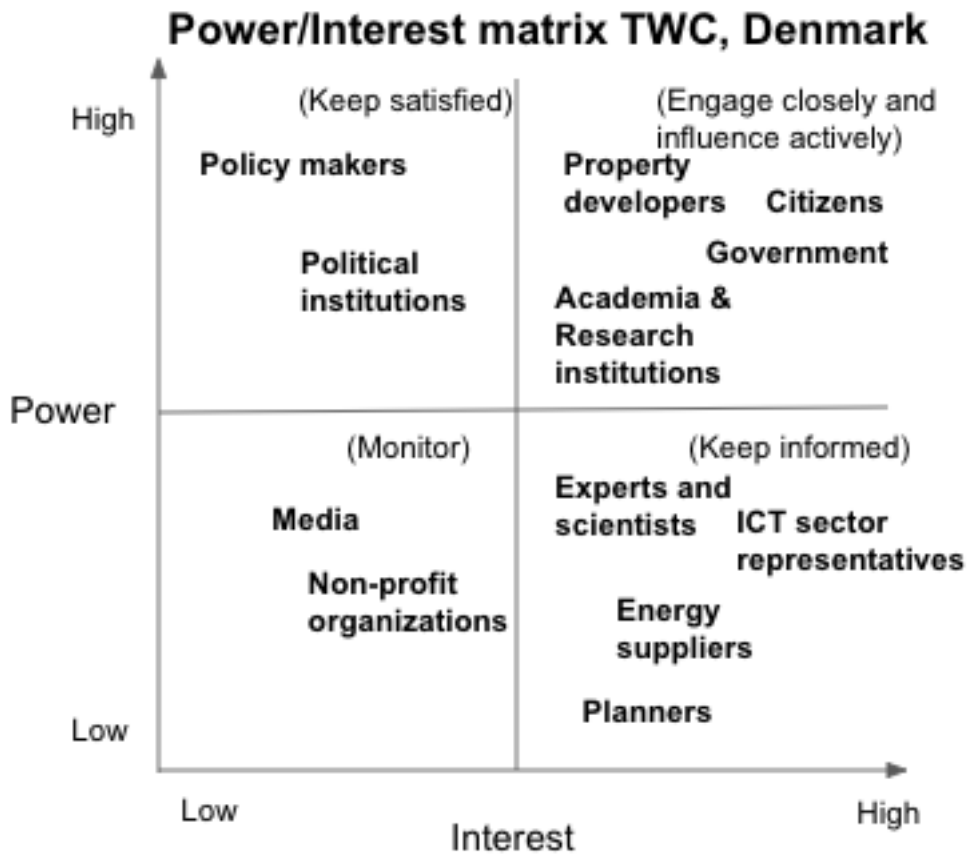


Figure 10. Depiction of identified stakeholders for a TWC project in Denmark mapped on a power/interest grid. Own depiction, 2022.

Mendelow's power/interest matrix visualizes the variation in the mapping of stakeholders for the TWC project in Japan and a TWC project in a Danish context (Mendelow, 1991). Some of the most noticeable variations include the fact that a TWC project in a Danish context would not be created by a private company, like Toyota, but instead use private-public partnerships (PPP-models) where private companies with attractive products and the incentive to maintain the buildings go together with public municipal actors to lead the project with urban planning, regulations, and laws (Nielsen, Jensen, Appendix 2). As a result of using PPP-models, the top right quadrant, the high-power and high-interest stakeholders, now involve the Danish government and property developers, where the government category was beforehand placed in the upper left quadrant (ibid.). Therefore, the stakeholder categories, government, political institutions, and policy makers, were placed in both high-power quadrants. Academia and research institutions are also placed in the upper right quadrant due to the large concentration and funding, creating a large pool of talent available with knowledge, ideas, and creation of new innovations (Indeed, 2021). With the large interest in sustainability and green energy in

Denmark to reach sustainability goals, the ICT sector representatives and energy suppliers were placed with high interest to guide and offer advice on emerging issues (ibid.).

The experts and scientists, energy suppliers, and planners are still mapped in the lower right quadrant, high-interest low-power, as the groups have some influence over a TWC project in Denmark but are not able to change the project directly (Indeed, 2021). To this, planners are placed higher in the TWC project in a Danish context than a Japanese, as TWC in Japan is privately owned whereas the Danish context would make use of PPP-models and the planners should thus be kept informed in case of emerging issues (ibid.). The media category was moved to the bottom left quadrant together with non-profit organizations for TWC in a Danish context as these stakeholders cannot directly influence the project and have little impact where media placed higher for TWC in Japan due to Toyotas own news platforms, newspapers, and forums (ibid.). After a brief section on stakeholder limitations, this concludes the stakeholder section of the analysis, which will then move on to the sustainability section of the analysis.

6.1.2 Stakeholder limitations

The identification of stakeholders involved in TWC was gathered and analyzed during the completion of the thesis. Following the completion of the thesis, additional stakeholders may be added, which were not accounted for in this analysis due to TWC not being a finished project. Thus, the stakeholder categories, such as policy makers, academia and research institutions, non-profit organizations, and political institutions were left open for TWC in Japan at this stage. The stakeholder identification and mapping for TWC in a Danish context was created as a potential version from the information and expertise given from the interview subjects, online announcements, and info from other industry leaders in Denmark. Therefore, it is a non-exhaustive list of identified stakeholders for a TWC project in Denmark, which has then been mapped according to importance.

6.2 Sustainability

This sustainability section will contain the UN's sustainability goals and Tokyo and Denmark's effort to reach them, investigating the choice of green energy and supplementary energy, and green construction.

6.2.1 Global, Toyota & Japan's, and Denmark & Europe's SDG's & carbon neutrality goals

The United Nations[7] Sustainable Development Goals[8] (SDGs) were set in 2015 by the international community as part of the UN 2030 Agenda for Sustainable Development where 17 SDGs were defined with 169 targets to be reached by 2030, which both Japan and Denmark are part of (Appendix 13, European Commission, 2022). These are the goals to which both the Japanese and Danish national contexts strive towards. Additionally, the world's most urgent mission is to build a global coalition for carbon neutrality by 2050, which the European Union[9] has committed to as well as Japan and more than 110 other countries (Guterres, 2020).

Japan contributed to the SDG negotiation process relating to the SDG's and established an SDG Promotion Headquarters in 2016 to carry out the UN's 2030 agenda where Japan's latest SDG action plan, "SDG Action Plan 2020" is especially involved good health and well-being (SDG 3), quality education (SDG 4), gender equality with women empowerment (SDG 5), quality infrastructure (SDG 9), climate change (SDG 13), and marine plastic litter (SDG 14) (Ministry of Foreign Affairs of Japan, 2020). Visible on Toyota's website, it states that "we believe that true achievement comes from supporting our customers, partners, employees, and the communities in which we operate. Since our founding over 80 years ago in 1937, we have applied our Guiding Principles in pursuit of a safer, greener and more inclusive society. Today, as we transform into a mobility company developing connected, automated, shared and electrified technologies, we also remain true to our Guiding Principles and many of the United Nations' Sustainable Development Goals to help realize an ever-better world, where everyone is free to move" (Toyota Sustainable Development Goals, 2022). Especially through Toyota's TWC partnership with ENEOS, for the utilization and application of hydrogen to fuel the TWC project through a hydrogen-based supply chain, the two companies aim to help achieve a carbon-neutral society by 2050 (Toyota Newsroom, 2021).

Europe's approach to carrying out UN's 2030 agenda and reach the goals is under chairman Ursula von de Leyen (European Commission chairman), which was explained by Nielsen: "Ursula von der Leyen who has the driving stick in Bruxelles, when she decided last summer that we got this "Fit for 55" where Europe must reach 55 percent CO2 reduction by 2030, she

[7] From here on out referred to as "UN".
[8] From here on out referred to as "SDGs".
[9] From here on out referred to as "EU".

said that if we are to reach that then we must think of green transition in all aspects" (Nielsen, Appendix 7, p. 53). As a step towards achieving climate neutrality by 2050, EU has increased its climate ambition for 2030 as EU has committed to reducing CO2 emissions by at least 55 percent by 2030, where the "Fit for 55" package consists of a series of proposals and initiatives to ensure that EU is in line with the goals (Det Europæiske Råd, 2022).

To reach the UN's 2030 goals, Denmark has created CO2 requirements for new construction projects from 2023, "In 2023 there will be mandatory carbon limits on anything that you build in Denmark" (Jacobson, Appendix 3, p. 25). From 2023, new and large construction projects must not emit more than 12 kg CO2/m2/year over a 50-year period of the project's life (Andersen, 2021). Additionally, Nielsen explains that "the brick factories in Denmark are to reduce their CO2 emissions by 70 percent by 2030" which is an additional limit enforced by the Danish government as an effort to make use of current resources and old materials when creating new projects (Nielsen, Appendix 7, p. 54). Even Danish local communities create goals as "a lot of cities are engaged in the DK 2020 collaboration (…). DK 2020 is a collaboration where at least two thirds of the country's municipalities are involved. It's sort of a framework tool (…). How do we get the world goals translated in our local contexts in the individual municipality with the profile they operate in (Axelsen, Appendix 6, p. 42). An example is Albertslund municipality which has set a "2025 goal in their climate plan (…) 90% of children and adolescents must walk or ride their bicycle to school" (Axelsen, Appendix 6, p. 43). Another example is Odense municipality which as chosen "on a political level to be CO2 neutral in 2030" where Odense's aim is to become the world's best robot city and CO2 neutral in 2030" (Elcer, Appendix 4, p. 31, Craggs, Appendix 5, p. 36). It is worth noting how dedicated both Japan and Denmark are in reaching UN's 2030 and the global coalition for carbon neutrality by 2050 goals where Denmark's individual municipalities are even setting their own goals and the Danish government is implementing limits in the construction industry, which will be further discussed in the following sustainable construction section and additionally used for branding of a TWC project in a Danish context.

6.2.2 Sustainable construction and green energy transition

It is important when investigating sustainability aspect of smart cities to also explore the aspect of the actual construction of a smart city as Nielsen succinctly explains: "the construction is responsible for insane amounts of energy and materials, so we just have to get started" (Nielsen,

Appendix 7, p 53). Jensen also touched upon the aspect by stating that "I think it's 30 percent of the world's emissions that are from the construction sector, so it has a large share where you could reduce" (Jensen, Appendix 2, p. 16). As described in the introduction for the thesis, TWC's buildings in Japan will be made mostly from wood to minimize carbon footprint, using traditional Japanese joinery, combined with robotic production methods, to merge traditional Japan with the future (Toyota, 2022). The buildings will advance mass timber construction, with carbon-sequestering wood, to combine Japanese craftsmanship with robotic fabrication technology whilst creating less CO2 emissions than using traditional wood (BIG, 2022).

According to Nielsen, "some people believe that everything should be constructed using wood", like the TWC project in Japan (Nielsen, Appendix 7, p. 54). However, it is apparent that the understanding of what sustainable construction entails changes meaning when changing the context into the Danish landscape as**,** according to Nielsen, materials used should be considered from the view of how exposed the building is and what it should be used for since the climate varies greatly from Japan to Denmark (ibid.). Nielsen underlines her statement by explaining that "you can't build a windmill out of wood, you can't build a bridge out of wood, and you can't build a foundation in the ground out of wood. It will rot. Instead of building everything in tree, we should pick the right materials, where we are going to use them" (ibid.). Therefore, the choice of materials should depend on what exactly is being built but also how exposed the project is and what the local climate entails. The Danish climate has certain characteristics, which differ from the Japanese and even the neighboring countries to Denmark. "We have a lot of wind, and we actually have a lot more moisture than any other country. We also have more moisture than Sweden. So, when people say that there is a lot of wooden houses in Sweden, well, Sweden does not have as much rainfall as us" (ibid.). In fact, on average it rains 179 days in Denmark, which corresponds to rainfall every other day with an increase in the recent years (Danishrainwear, 2022). The Danish climate is an important factor to consider as it has an impact on the chosen materials and "it impacts the materials if they stay wet all the time in a construction. It cannot withstand it. We also get a bad indoor climate if we get mold" (Nielsen, Appendix 7, p. 55). In Shizuoka, Japan, there is an average of 219 sunny days per year, which creates an entirely different context for how to sustainably construct than the Danish context (Current results, 2022). To this, Jacobson explained that "Toyota were interested in sunlight, the shape of the buildings, and when you get sunlight where. In Japan, there are very specific rules about how much sunlight each individual apartment needs to

receive" (Jacobson, Appendix 3, p. 18). The Japanese term *Nissho-ken* (日照権) explains "the right to sunshine", which laws the height and shape of buildings in Japan stemming from the entanglements of urban building of skyscrapers in Japan that cover many of the smaller buildings and private homes (Parker, 2016).

When discussing materials for building a TWC project in a Danish context, Nielsen states that "masonry uses a lot of energy but there is no doubt that it's like Rockwool and other steel producers, which use a lot of energy. They have all discovered that if they do not get it fixed, then they're not part of the construction of the future" (Nielsen, Appendix 7, p. 54). Nielsen is convinced that, in Denmark, alternative versions of masonry will emerge, which will be used for futuristic construction projects, such as a smart city: "in the long run, I don't think we will have these intense discussions about materials, which we have today, since you would then produce bricks that do not have a climate footprint and then it comes out the same (…). We will be able to do that" (ibid.). An additional aspect to constructing a smart city lies in the type of buildings. Nielsen explains "if we are to use less energy, we have to live closer. It requires less materials and less energy for heating. So high-rise apartment buildings, we will see many more of those (Nielsen, Appendix 7, p. 55). Nielsen's statement correlates with the choice of materials for constructing a smart city as "there are challenges by building high-rise buildings. We need strength and security so we can be sure the buildings can withstand exposure to Danish weather" (ibid.). High-rise apartment buildings need less energy to heat up the apartments, require a lower amount of materials for construction, and should be securely constructed using bricks without a climate footprint to withstand the climate of the given local context, which is humid and rainy for Denmark. Whereas TWC in Japan will be made mostly of wood, a TWC project in a Danish context should instead be constructed using bricks, which do not leave a carbon footprint, which also creates a strong foundation for the high-rise apartment buildings. The choice of using bricks that do not leave a climate footprint would thus be the choice of sustainable construction material for a TWC project in a Danish context.

6.2.3 The choice of green energy

Previously described in the stakeholder analysis, Toyota and ENEOS have created a partnership for the TWC project in Japan to make use of and apply hydrogen fuel cell energy together with solar energy and geothermal energy to make TWC a fully carbon-neutral smart city (BIG, 2022). ENEOS already operates 45 commercial hydrogen refueling stations across

the four major metropolitan areas in Japan and Toyota has already invested in hydrogen as one of the most viable energy sources for a futuristic city (Toyota Newsroom, 2021). To this, ENEOS will install a refueling station near TWC that will supply the fuel cell generators of TWC, a supply and demand management system, and research hydrogen supply in the city (Ramirez, 2021).

Following the interview subjects' statements and explanations, hydrogen fuel cell energy seems to also be a viable answer for a TWC project in a Danish context. However, hydrogen should be complimented with green energy solutions, such as wind energy as natural resources differ to the Danish context. Generally, the global market for green hydrogen is expected to rise at an explosive rate towards the years 2030, 2040, and 2050 and the Danish landscape carries positive and substantial preconditions to gain a strong position within PtX (Dansk Energi, 2022). Jacobson explained that "hydrogen is different than just a battery because when you release the energy you get half heat and half electricity, instead of just electricity. In cars, a lot of heat goes to waste. That's a bad thing but in buildings, we use heat all the time and that can be an asset (…). The most difficult thing about hydrogen is producing the hydrogen and storing it and transporting it because hydrogen atoms, they are the smallest atoms in the entire periodic table. They leak through everything (…). I think the fact that Danes have heating bills for most of the year makes hydrogen a natural technology to explore and look at" (Jacobson, Appendix 3, p. 18, 23). Hydrogen is therefore a natural resource to explore, and Denmark already produces large quantities of green electricity, which is expected to grow towards 2050 and Denmark is geographically located well for building and becoming a part of the North European hydrogen infrastructure network along with opportunities to store hydrogen in underground caves, previously storing natural gasses (Dansk Energi, 2022).

The aspect of storing of hydrogen can therefore be solved where Jacobson adds that "there are issues like that but then I think that wind energy can partner really well with hydrogen energy because you need the electricity that's generated by wind in order to charge the hydrogen fuel cells" (Jacobson, Appendix 3, p. 23). TWC in Japan supplements hydrogen with the country's natural resources with geothermal energy, from Mt. Fuji, and solar energy, from Shizuoka's 219 sunny days a year (Current results, 2022). For the Danish context, one of the largest natural resources in Denmark to supplement hydrogen is wind, which was mentioned by interview subjects: Jensen, Jacobson, and Craggs. As Axelsen succinctly explains "it makes sense to make use of the resources one naturally has access to in the best possible way" (Axelsen,

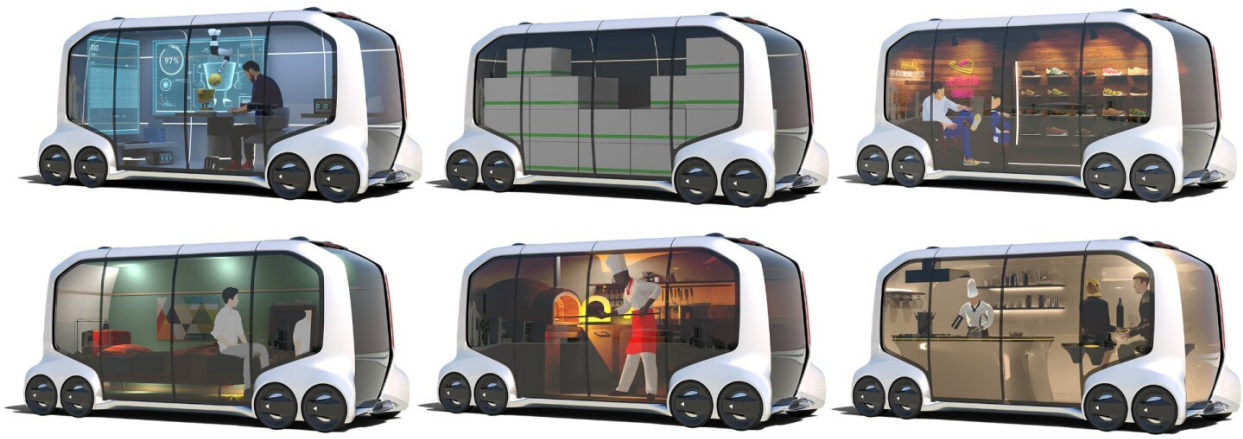
Appendix 6, p. 47). Jensen mentioned wind energy by stating that ”we have a lot of offshore wind in Denmark. Large wind turbines. The west coast of Jutland is filled with them (…). This means that we produce a lot of green electricity, we have also invested a lot in it, so we have all this green electricity that we can distribute around Denmark, which means that most households in Denmark can get green electricity that does not use CO2” (Jensen, Appendix 2, p. 11). Craggs adds “the most obvious is to say wind and green energy” (Craggs, Appendix 5). It is important to state that, argued from the interviews, wind should be chosen as a supplement to hydrogen as both were argued to have conditions too weak to be the sole source of energy. As Jacobson explained, electricity is needed to charge the hydrogen fuel cells that would be generated by wind in a Danish context, which also cannot stand alone as “it’s too vulnerable to bet on wind or sun alone” (Nielsen, Appendix 7, p. 58). When the wind doesn’t blow or the sun doesn’t shine, energy cannot be generated, and Denmark has an average of 179 rainy days a year as opposed to Shizuoka’s 219 sunny days per year (ibid.).

6.3 Robotics & AI

The robotics & AI section will contain smart mobility in investigating TWC Japan’s three-split road and autonomous vehicles in relation to the Danish context and legislation process for emerging technology, continue to address the digitalization aspect of smart cities, and round off by comparing the aspect of digital trust in Japan and Denmark.

6.3.1 Smart mobility

TWC in Japan specializes in smart mobility by broadening the company’s scope to include everyday mobility of people, goods, and information (Toyota Woven City, 2022). The BIG architect, Jacobson, explains that “Toyota is not really trying to sell cars or vehicles so much as they’re trying to sell the service of mobility. This is a trend generally in the mobility industry that changes the way people own and interact with vehicles” (Jacobson, Appendix 3, p. 22). TWC includes the designation of a flexible network of streets for three types of usages of mobility (Toyota, 2022). The primary street will be optimized for faster autonomous vehicles where the self-driven Toyota e-Palette (a multi-passenger, multi-purpose vehicle) will be utilized for shared transportation and delivery services, mobile retail, food, medical clinics, hotels, and workplaces whereas logistical traffic will be placed underneath, visualized below (BIG, 2022).



Depiction of the Toyota e-Palette. Source: Toyota's global newsroom, 2022.

The flexible network of the three-split roads and its autonomous vehicles were presented with a neutral description for the interview subjects to express their individual opinions. Nielsen explained that in the Danish context in relation to saving resources and energy that "I think that there will be much fewer cars. I laugh a little when they build parking garages in Copenhagen today" (Nielsen, Appendix 7, p. 57). Jacobson argued that TWC's three-split roads and its designation for types of mobility have "really direct connections with the Danish mobility systems, because, I mean, Danish cities have been very deliberately planned to use bicycles and cars and to walk, and these multiple layers of circulation. It's different junctions within each speed, let's say, and distance" (Jacobson, Appendix 3, p. 20). Nielsen was also able to envision that the autonomous vehicles would be able to be used as Nielsen explained that "it will come (…). There is already one driving around campus at DTU. It is like a safety perspective to have those autonomous cars and have them drive in some slightly firmer tracks. I definitely think we'll see that" (Nielsen, Appendix 7, p. 57).

The aspect of living in a city with autonomous vehicles where citizens are able to effortlessly move from a to b without having to own a car was met by positive attitudes from Jacobson and Nielsen. Jacobson, who moved from LA to Copenhagen, doesn't comment of whether it would be possible in a Danish context to create an isolated city where non-autonomous vehicles cannot drive on the road, but views the aspect positively as he himself moved to Copenhagen "partly also because I liked the way of getting around Copenhagen. The idea of being able to go everywhere by bike. I don't own a car. I don't need a car" (Jacobson, Appendix 3, p. 25). Danes, and especially citizens located in Copenhagen, are regarded as highly environmentally conscious as well as reliant on bikes, and as well as increasingly reliant on shared cars, to get

from a to b (ibid.). Jacobson's view can be assumed to reflect many other Copenhagen-residents in a similar age range and mindset as Jacobson, which would make the group more easily adapt to autonomous vehicles and three-split roads, as there would not be a large shift in meaning, which also have a positive meaning attached (Jacobson, Appendix 3, Brannen, 2004).

When investigating the current testing of autonomous vehicles and emerging technology in a Danish context, it was visible that the process is "very slow and heavy" with little development (Axelsen, Appendix 6, p. 47). In general, "you need a lot of permission to test and so, having a private city that creates the conditions of the world that you imagine is really a valuable tool for your own development as a company" (Jacobson, Appendix 3, p. 20). Jensen explains about the testing of new technologies in the Danish context that "where we can optimize is by creating new legislations, which does so you can for example make areas where you are able to test drones and you can fly drones in a different manner or that we make it possible to use robots in production and that we don't have any legislations, which are in the way" (Jensen, Appendix 2, p. 14). Legislation processes are a current challenge for testing new technologies in Denmark where "it will always be the way that something catches up with the other, where sometimes the technology will be ahead, then you have some legislations or a way we have to work with it that has to catch up and then sometimes technology catches up and takes over" (Axelsen, Appendix 6, p. 51). However, as of 2022, autonomous vehicles are still only being tested at isolated test sites, such as at DTU, due to legislations and safety, where only few autonomous bus "shuttles" have been tested on short routes on public streets, for example in Aalborg or Slagelse (Ritzaus Bureau, 2021). Professor in robot technology and AI at ITU (IT-Universitetet), argues that "it will probably take 10 years before driverless cars will drive on any Danish roads" and is skeptical whether driverless cars will ever be rolled out to the general public in Denmark as "I think that's far into the future and in the end I'm a little bit pessimistic whether it will ever happen" (ibid.). Therefore, as autonomous vehicles could be unable to ever be implemented in a Danish context, this aspect shows no ground for isomorphic processes, to which no recontextualization can happen.

6.3.2 Digitalization of smart cities

The name "woven" stems from the interwoven streets but also from the idea of having sensors scattered throughout the city, in buildings, streets, and inside homes to connect and interweave people, buildings, and vehicles through data and sensors (Toyota Newsroom, 2020). Smart

cities include usage of ICT to improve urban efficiency with sensors, digital twin technologies, and other digital technologies (ibid.). Axelsen mentioned that Doll Living Lab have experience with ITS (Intelligent Transport Systems), an application that involves distance sensors and lane departure warnings, which TWC will also enforce in its approach in using autonomous vehicles (Axelsen, Appendix 6, p. 44). ITS enables the user a smart use of transport networks where Axelsen explains that "we are on our way to establishing that (…). We already know it to some extent today. The buses get green light. We are looking into what if we have some heavy vehicles, such as trucks or vans. If the traffic light could assess when these vans or trucks come, then it pays off to keep the intersection open for three or ten seconds more. Then we get the heavy vehicles across and avoid the concentrated air pollution" (ibid.). Environmental monitoring is a way for authorities to monitor and analyze the environmental factors using digital technology, in relation to areas such as air quality, traffic flow, noise levels, waste containers, etc. and the associated needs (Toyota Newsroom, 2020). "The sensors do not take into account who you are, etc., but simply translate you into a device, a piece in a way" (ibid.). Nakajima explains that Japanese culture "is a bit unique because in some areas we utilize emerging and advanced technologies in the right way and many people like robotics and other ICT technologies but at the same time, the level of digitalization in the social infrastructures, like healthcare of mobility or retail, our level of digitalization is behind China, Korea, and of course Denmark" (Nakajima, Appendix 8, p. 69).

TWC uses a "software first" approach by building digital models to help them develop and improve the real-life city by extensive trial-and-error (Toyota Times, 2021). The approach is developed where an identical digital copy of a real-world project is created and used for simulations (Aikawa, Appendix 1, p. 7, Toyota Times, 2021). BIG is working closely with Toyota to create and design TWC with digital twin by "exploring possibilities that arise from digital twin and the relationship between what we can model, and test is a simulation versus what actually happens because there's a big difference, there always is" (Jacobson, Appendix 3, p. 21). For efficient future city development "digital twin will be one of the most important tools. Before we developed the digital technology like digital twin, when we tried to create new cities, buildings, and the good infrastructures, we had to create the prototype in the beginning and needed to adjust by trial and error (…). When we utilize digital twin, we don't need to prepare the materials or buildings in the digital twin space. Just the digital technology is almost zero cost" (Nakajima, Appendix 8, p. 65).

As mentioned in the stakeholder analysis, the Danish version of digital twin is used in companies, such as MT Højgaard and NCC, which make use of the digital technology referred to as VDC (Virtual Design and Construction) in designing and constructing projects and work progresses (Nielsen, Appendix 7, MT Højgaard, 2022). Where digital twin is used mostly in TWC to test new technologies and solutions in relation to city development and climate, whereas Denmark uses VDC as an attempt to collision check and create an overview with data for everyone involved in the project as the constructor, architect, entrepreneur, the bricklayer and so forth, do not share data and so "all sorts of mistakes occur, so they tried to make a large datacenter where we all have the same drawings everyone looks at every time (Nielsen, Appendix 7, p. 59). From Nielsen statements, it is visible that the usage of digital twin technologies has recontextualized in Denmark and instead gained the meaning of being able to solve communication and alignment matters as opposed to testing more efficient and futuristic solutions for urban planning as digital twin is viewed in Japan as a "quite important tool and brings impact to the future" (Nakajima, Appendix 8, p. 68). On the construction side, Denmark is "on our way but it is still not digitalized enough, so we could pick up on that. Much better planning, fewer errors, and fewer construction stops (Nielsen, Appendix 7, p. 59).

6.3.3 Digital trust

According to Jensen, "Denmark is one of the most digitalized counties in the world. We have a large pool of patient data because we have the CPR register (…). There is a high level of social trust in Denmark, so if you want to make clinical trials, etc. then it is fairly easy to get a population of patients to test on in Denmark because we have social trust and collaboration" (Jensen, Appendix 2, p. 13). Nakajima explains that Japanese culture "is a bit unique because in some areas we utilize emerging and advanced technologies in the right way and many people like robotics and other ICT technologies but at the same time, the level of digitalization in the social infrastructures, like healthcare of mobility or retail, or level of digitalization is behind China, Korea, and of course Denmark" (Nakajima, Appendix 8, p. 69). In relation to the sensor and digitalization aspect in Denmark, mentioned in a previous section, "we have GDPR and all sorts of stuff and that means that it also sets some minimum requirements for what a sensor can detect. It counts X number of pieces, so it isn't person attributable" (Axelsen, Appendix 6, p. 50).

Relating the aspect to the usage of PPP-models in the stakeholder analysis section, Nakajima explains that "Denmark is one of the good locations to realize the trust between municipality, citizens, institutions, and companies (…). How can we transfer our trust in real life to the virtual trust? Trust is very important" (Nakajima, Appendix 8, p. 67). Nakajima adds that there is a difference in the trust structure in Denmark and the Nordics to the trust structure in Japan: "Huge difference. Of course, our society has something like trust, but the meaning of trust is a little different (…). Europe and the Nordics are advanced countries to realize a good balance of the democracy but on the other hand the Asian countries, including Japan, we also realize the democracy, but the main activities started after World War II (…). I don't say we don't have trust, but our trust is linked to something like a safe, safety. There is a misunderstanding between safe and trust issues. We, Japanese, if we feel safe then many people misunderstand it as something that feels like trust… It's quite different categories. To be honest, I don't think we have a Nordic type of trust in our society. Still, we are struggling to figure out how we can create good trust in city management" (ibid.). The Japanese are keen on adapting and relying on emerging technology, which are produced with high quality in Japan, however, "we, Japanese, like robotics and AI and are happy to accept new technology in our daily life but that doesn't relate to the trust (ibid.).

Following Hofstede's uncertainty avoidance dimension, with a score of 92, Japan is a country with one of the highest scores globally, due to its constant threat of natural disasters (Appendix 16, Hofstede, 1983). The score relates to Nakajima's statement about the Japanese valuing the feeling of safety, which can be misunderstood as trust, as the Japanese have a culture of preparing themselves for any uncertain situation with highly ritualized lives (ibid.). The Japanese do not cope as well with unpredictability as Danes, with a lower score of 23, where predictability is not as needed, and changes overnight are viewed as part of life (ibid.). Nakajima explains that "once we install the very advanced digital technologies, in our society, that might bring a quite negative impact to the existing industries" which is also an aspect to the nation's relationship to unpredictability of changes (Nakajima, Appendix 8, p. 70). Additionally, Nakajima explains that the risk of digital technologies stems from cyber-attack issues "our society is everyday attacked by some other countries, that is China, they attack our energy infrastructure through cyber-attacks" where Nakajima uses the cashless systems as an example as the Japanese still carry cash, which again shows how the Japanese highly value the feeling of safety instead of trust, and do not have a high level of digital trust (ibid.). Danes'

attitudes towards a TWC project in Denmark will be further investigated in the idea of a smart city section of the analysis.

6.3 The idea of a smart city

This section will include explanations from the interview subjects regarding Danes attitudes towards a TWC project in Denmark as well as the aspects to be included in a branding strategy to attract Danes to live there, should a TWC project be built in Denmark tomorrow.

6.4.1 Attitudes

When discussing whether Danes are as ready as the Japanese for a TWC project, Jacobson positively argues that "I think you always have early adapters. You always have people who are willing to try and spread things and share it that way. I have faith. I feel like I'm surrounded by people who are willing to make changes in their day-to-day way of doing things to align themselves better with what they believe so I don't see why there would be any resistance" (Jacobson, Appendix 3, p. 26). Jacobson's statement is derived from his personal mindset as he earlier explained that "personally, I really like to experiment and be an early adapter on a lot of things" and his work background in BIG, which is known to create innovative and futuristic projects (Jacobson, Appendix 3, p. 21, BIG, 2022).

Nielsen, the director of the trade association Danske Tegl, argues that it is possible to get Danes to live in a TWC project in Denmark in relation to multi-generational living facilities: "I'm sure people will think it's a way of living that they want to" (Nielsen, Appendix 7, p. 62). However, she explains that she can imagine skepticism in relation to robots in the city landscape "because it isn't very Danish (…). I think that there is some resistance. It's very foreign, it's very far from the street pond (gadekær) but I also think that we will approach a time where we need some help. We don't have enough hands for everything so I actually think it will come" (ibid.).

Elcer specifically focuses on the aspect of surveillance and citizens' attitudes where "surveillance is a bit harsh (…). It depends on the purpose. It can sometimes create a feeling of safety to monitor but then there must also be a purpose to the monitoring" but when later asked if citizens from Odense or the rest of Denmark would be interested in living in an isolated smart city, Elcer answers "yes, I think so. There are always some people who think it's fun to

be in such a city or district (Elcer, Appendix 4, p. 29). To this, Axelsen also wavers between the pros and cons of a TWC project in Denmark and the attitude of Danes towards it, as he explains "it depends on how much it pushes the limits we are used to working with. There are also many ideas, thoughts, and concrete examples of what the city of the future is when we discuss technology and green transition (…) or you go with, seen with our eyes, a relatively strict direction where you have face recognition, you have data on a personal level (…) where everything is put in systems and boxes that way. It's something very very far from our mindset, and the same when you talk AI and autonomous vehicles… but if it is on a level where we think, okay, this makes good sense and it is in an arm-stretched context then there's not the same resistance towards it" (Axelsen, Appendix 6, p. 50). The last statement is explained in relation to GDPR in Denmark where monitoring and new technologies cannot be attributed to individuals "that is probably the interface we've reached right now as acceptable" (ibid.).

Craggs argues that it wouldn't be as easy to get Danes to move into TWC as a smart city project in Denmark and argues "as a city I'm not sure. I think you have to view it in a more Danish context. This is on a very large scale" (Craggs, Appendix 5, p. 35). Craggs explains that Invest in Odense also works with "robots in the city landscape, where we try to get the robots out into the city so the citizens can see them. I can reveal that it's not super easy" (ibid.). Besides the local and national regulations for technology trials and testing, Craggs explains that skepticism towards robots is present in Odense as "although there are many in the city who are very positive towards robots and buy into the story that we have, not everyone wants robots in the city landscape (…). I have no doubt about that because that's how it is with Denmark" (Craggs, Appendix 5, p. 39.). Even though Jensen showed positivism towards attracting foreign companies as investors for a TWC project in Denmark, Jensen "is not sure it would work out in a Danish context" but has great insights in relations to efforts to get citizens for a TWC project in Denmark, which will be investigated further in the following section (Jensen, Appendix 2).

6.4.2 Smart City branding considerations

In relation to the attitudes of Danes in creating a TWC project in a Danish context, the aspect of branding and how to get citizens to want to come and live there was touched upon by a few of the interview subjects. Jensen explains that "there are a lot of ways you can plan a city to nudge people (…). You can nudge people to use public transport or green traffic by new

residential areas by not making enough parking spaces for all the land registers or doing something like shared cars, or green cars, and the charging stations you can share in groups if you live there or your apartment from excess heat" (Jensen, Appendix 2, p. 15). Danes are known to be environmentally conscious where Denmark has seen an increase in shared vehicles on the streets and Jensen adds that "I know that is done in the construction outside of Roskilde, by Trekroner, in the new residential areas. There are not enough parking spaces for all of the apartments that are there. They use the shared-car measures where you can only get a parking space if you are registered in the shared-car plan they have" (ibid.).

The aspect of nudging shared vehicles, facilities, or heat in a city supports the TWC's claims in Japan where autonomous vehicles are to be shared by the citizens, which will be Toyota employees and their families, which will also share apartments and facilities (Toyota Woven City, 2022). The aspect of mobility is, however, recontextualized in the Danish context to the meaning of shared non-autonomous vehicles and public transport as opposed to the three-split roads and its autonomous vehicles in Japan (ibid.). Nakajima explains that for Japan "many people are interested in emerging technology, new things (…). People are likely to use the emerging technology like robotics and AI", showing that even though the Japanese have a high uncertainty avoidance, the population is keen on adapting technological innovations as the Japanese view the emerging technology to have "huge impact to the city development in the future (…). The Japanese attitude towards robots, new technologies, and smart cities is that many people believe that technology will open up a new future" (Nakajima, Appendix 8, p. 67).

The sustainability and reduction of carbon emissions aspect for branding should not only involve the aspect of shared vehicles but also the fact that TWC project in a Danish context is to be powered by green power using hydrogen and wind, where Jensen explains that "it should then be a sales pitch so if you chose to settle down here, then you knew you were getting green power one way or another. I think that in urban planning you can appeal to those who personally want to reduce their CO2 footprint (…). I think there are a lot of Danes who would like that. You can see it from how occupied the Danes are with climate matters" (Jensen, Appendix 2, p. 16). Additionally, Denmark is known for its architecture and constructing sustainably, which adheres to the aspect of not just attracting citizens but also investors for a TWC project in Denmark as Jensen explains that "Denmark is very far ahead in architecture and there are large private equity funds in Denmark that are responsible for construction, who brand themselves

on sustainable construction, which is their goal, and gather investors on the basis that they deliver a product that is sustainable" (ibid.).

Adding to the architecture and planning aspect, it is argued that part of the branding must include aspects, nature, or artifacts that the national population knows or has a relation to (Jacobson, Appendix 3). For TWC in Japan, the architect Jacobson explains that "to be in the shadow of Mt. Fuji and have that as part of the scene, it lands an importance to the place that wouldn't otherwise be there (…). Mt. Fuji has been part of your everyday life in Japan for thousands of years, so leaning the technology to that and just placing them in the same scene, it makes it easier to imagine how their life might be in their future by taking something familiar" (Jacobson, Appendix 3, p. 19). Nielsen also mentions the point of using part of the national scene in Denmark with something the national citizens know by stating "we like things we can recognize. An example is Nordhavn, which is not Greenfield, but they have left part of some and parts of other old buildings and then you have built a bit on top, so the storytelling is there. I think it's the same with nature, that you don't plan it out and get a landscape architect to plant some trees in the right places (…). Use everything that speaks to us." (Nielsen, Appendix 7, p. 56). From the visualizations and description on BIG's website, it is visible that in the TWC in Japan flora, the plant-life, will be very planned and mapped via the recreational promenade and the linear park for pedestrians where the locations have been carefully considered to fit the squares or plaza in the middle of the city, which is visualized in appendix 15 (BIG, 2022, Appendix 15). As Nielsen explains, in Denmark it is not as usual to plan out nature to fit into certain spaces but instead keep nature wild and build around it, which also makes sense in relation to using the Danish landscape for branding "if I had to place a city then I would place it somewhere where there is something exciting in the landscape, that I would build my city around, some things that I could use, which could be lakes or something else, like a natural forest" (Nielsen, Appendix 7, p. 56).

This creates the understanding that to efficiently brand a smart city and attract citizens to live there, there must be the notion of something the nation relates to and knows in their everyday lives where Nakajima expands on the aspect by arguing that "to brand the good smart city would be the fusion of tradition and innovations. So, respect to the traditional way of living, the traditional products, traditional business customs but at the same time, the world is changing day by day, so we also need to implement the new technologies. We always have to consider the good balance and fusion of the technologies and our old lives" (Nakajima,

Appendix 8, p. 73). Thus, using part of the nation's traditional values by using an aspect, which the potential citizens recognize, is viewed the same in both Japan and Denmark in branding a smart city, where the meanings of how to combine traditions with innovations has a recontextualized meaning in the Danish landscape, which will be further investigated in the following discussion section.

7. Discussion

The following section will contain a discussion, which will be split into three subsections. The initial section will contain a discussion of the advantages of implementing a TWC smart city project into a Danish landscape context, which are recontextualized to have positive outcomes. The following section will contain a discussion regarding the implications for practice for moving a TWC project from a Japanese context to a Danish one, which are recontextualized to have negative outcomes. The discussion section will be rounded off with the remaining considerations, which would be recontextualized in a Danish landscape, but not necessarily viewed as negative or positive, as well as considerations which showed no grounds for isomorphic processes if moved into the Danish landscape. The considerations discussed throughout the following sections should be viewed as critical for the success of implementation of a TWC project in a Danish context to achieve a competitive advantage by using the national institutions and culture that thus, need to be carefully considered for project success. Rounding off the discussion section, the discussed considerations will be categorized and depicted in a figure to create a clear overview for implementation of a TWC project in a Danish context.

7.1 Advantages of implementing a TWC smart city in Denmark

Present in the analysis section, when considering moving TWC into a Danish context, there are certain beneficial outcomes visible from positive recontextualization, which can be considered for gaining a competitive advantage in creating a TWC project in a Danish context.

7.1.1 PPP-models

The first analysis section, stakeholder identification and mapping, presented results showing that a TWC project in Denmark would include using a PPP-model as opposed to TWC in Japan, which is a project envisioned and financed by Toyota. As a privately-owned project located on a Toyota owned property, Toyota gains the advantage of being able to create a clean-slate smart

city from scratch, in the sense that Toyota does not need to consider older systems, existing buildings, or existing citizens and is able to install everything related to emerging technologies, digital twin, sensors, robotics, AI, enabling Toyota to create the smart city of the future quicker and as a whole (Nakajima, Appendix 8). However, it is worth noting that TWC can be argued to seem like an R&D city instead of a real city, as also the citizens will be Toyota employees, which creates a city which instead resembles a testbed for testing new technologies in internal Toyota employees as opposed to first-mover, futuristic city enthusiasts in the general Japanese citizens. Creating a TWC project in Denmark by using a PPP-model, creates a higher level of trust in Danes as Axelsen explained that "we have greater trust that it will be managed in our public institutions rather than some random company" as PPP-models are regularly used in Denmark, which can stem from Danes claiming urban space to be "theirs", where Danes put trust in a local municipality to handle their data securely (Axelsen, Appendix 6, p. 51). Recontextualizing the aspect of stakeholders created the meaning of using PPP-models, which was viewed as positive and should be used to gain a competitive advantage should a TWC project be implemented in Denmark.

7.1.2 Digitalization and trust

Adding to the aspect of level of trust, the robotics & AI analysis section presented results, which showed the fact that Japan is ahead of Denmark in creating more efficient and futuristic solutions for urban planning and tech but is behind Denmark in the level of digitalization in social infrastructures, such as healthcare or retail (Nakajima, Appendix 1). The aspect can be viewed as positive recontextualization, as it showed that Denmark has little lack of digital and social trust as a result of a high level of digitalization in social infrastructures. With a CPR register and GDPR rules, it has created an interface where the Danes trust municipalities and governments to handle their personal data, argued to be positive recontextualization, which can be used for testing new digital solutions involved in creating a smart city project since Denmark has a high level of trust between municipalities, citizens, and institutions (ibid.). This is arguably due to Denmark being a highly transparent and low corruption country with flat hierarchies in organizations and between organizations and authorities, whereas, according to Nakajima, the Japanese instead link trust to safety (Jensen, Nakajima, Appendix 1). The aspect of safety in Japan varies greatly from Denmark in its uncertainty avoidance score (92), which can be attributed to Japan's history of natural disasters, where the Japanese thus views

emerging technology as a means to a safer future, whereas Denmark more so relates trust to the usage of personal data.

7.1.3 Branding

Correlated to the aspect of using PPP-models in a Danish context due to the aspect of Danes claiming urban space to be "theirs" and the potential skepticism to a TWC project as "not very Danish", the location and branding could include aspects, nature, or artifacts that the Danish population has a relation to. This consideration is also the same for TWC in Japan, which utilizes Mt. Fuji, as it makes it easier for potential citizens to imagine how their life might be in their future by taking something familiar to them (Jacobson, Appendix 3). Whether it includes part of old buildings or a part of the existing nature, people are more attracted to live in a new place when they recognize something.

When branding a smart city and creating a sales pitch for attracting citizens to live in a TWC project in Denmark, there are various sustainability aspects which can be included from the analysis. The potential citizens should be won on the fact that they can live in a smart city, which would be completely powered by green energy using hydrogen and wind as a natural resource, built with bricks which leave a lower carbon footprint, and the streets will offer shared vehicles to reduce carbon emissions (Nielsen, Appendix 7). The usage of the shared vehicles can be nudged to the level of creating too few parking spaces or by completely omitting parking places (ibid.). As Jacobson, architect in BIG, expressed that he would be surprised if BIG were not interested in being a partner in creating a TWC project in Denmark, this aspect could be used when branding as BIG is a Danish architect firm with a great reputation and the current leader within designing smart cities of the future (Jacobson, Appendix 3). Lastly, the wording used in describing the project could be an aspect worth considering, as Danes have a different relationship and attitude to monitoring or the relation to the word "living lab".

7.2 Obstacles in implementing a TWC smart city in Denmark

Following the considerations which can be recontextualized to have positive and beneficial outcomes, there are also considerations, which can be recontextualized to have negative outcomes and become clear implications that need to be considered to not become obstacles for implementation.

7.2.1 Danish legislations

From the robotics & AI analysis section, the aspect of the autonomous vehicles was analyzed to be recontextualized to have a negative outcome as the clear hindrance of a heavy and slow process of legislations is present in the Danish context. The aspect of slow processes in Danish legislations covers not only the testing and implementation of autonomous vehicles but also emerging technology, AI, robotics, and so forth, generally, in Denmark. Therefore, the Danish slow process of legislations and approvals is argued as the largest hindrance in Denmark for creating the more efficient and futuristic technological innovations quickly as opposed to TWC in Japan, which avoid the aspect as a "living lab" owned by Toyota. The TWC "living lab" is able to continuously test and implement new technology, which is an aspect that would be a hindrance when moving TWC to a Danish context where legislations are heavy and would thus be an aspect, which needs to be carefully considered before developing a smart city in Denmark to not become an obstacle.

7.2.2 Attitudes

In relation to the implementation of TWC and emerging technologies in a Danish context, explained in the idea of a smart city analysis section, few interview subjects weighed between the pros and cons of a TWC project in Denmark and the attitude of Danes towards it. However, most visible was the fact that many interview subjects leaned towards imagining skepticism from the Danish population claiming that it seems very foreign since it "isn't very Danish" (Nielsen, Appendix 7). In Odense, experiments with bringing robots into the city scenery has been conducted to where Elcer explained that it is more difficult than one might think where not all the citizens are open towards it (Elcer, Appendix 4). This aspect can arguably be viewed in relation to Denmark's history with robots, analyzed in the report from Nitto et al. (2017), where the Japanese showed a high level of familiarity with robots and associate robots with "humanoid robots", meaning robots that can communicate with humans whereas Danes, and Europeans, showed a strong tendency to consider robots for industrial purposes, a strong resistance towards robots in households, and did not view robots as companions (Nitto et al., 2017). This aspect can be correlated with the skepticism Elcer experienced from the citizens in Odense with placing robots in the city scenery as the robots would not be industrial but can be argued to be experienced as unfamiliar and unwelcomes as Danes showed resistance to robots in households, which are not far from the city landscape (ibid.).

Axelsen explained that the skepticism stems from the fact that TWC and its technologies, such as monitoring, AI, autonomous vehicles, and data gathering, are far from the Danish mindset where it needs to be in "an arm-stretched context" to make sense and decrease resistance by not pushing the current limits (Axelsen, Appendix 6). This is an interesting aspect to consider since, following Hofstede's cultural dimensions, Japan has one of the highest uncertainty avoidance scores (92) and Denmark has one of the lowest scores (23), where the interviews and report from Nitto et al. (2017) indicates the opposite (Hofstede Insights, 2022). The Japanese are normally viewed to be more reluctant to do new things without precedence and is thus a highly ritualized and ceremonial country, whereas Denmark is viewed to have little need for predictability and structure with acceptance of different and new innovations (ibid.). However, the interview subjects' claim that Danes' attitudes towards a TWC project and its technologies implemented in a Danish context would instead show a tendency to lean more towards skepticism and resistance, which can be argued to show quite the opposite of the normal uncertainty avoidance scores, where Denmark's score would suddenly be higher than Japan's. Arguably, this consideration would be important to keep in mind before implementing a TWC project in Denmark, in terms of citizens, as it can is recontextualized to have negative outcomes and thus, need to be researched and managed to not become an obstacle for successful implementation.

7.3 Additional criteria for successful implementation of smart cities and solutions in Denmark

There are some considerations present from the analysis, which can be argued to neither be recontextualized to have negative or positive outcomes but have simply been recontextualized into a different meaning or there are considerations which can be argued to have no basis for isomorphic processes for a TWC project in the Danish landscape.

7.3.1 Location in Denmark

The aspect of where a TWC project should be placed if implemented in the Danish landscape, was discussed with several of the experts during the interviews. Around the Odense area on Fyn was expressed by Craggs as a "good bet" as the robotics industry in Denmark is located around the ecosystem on Fyn, showing a large growth in the entrepreneurial environment (Craggs, Appendix 5). The robotics industry in Denmark is geographically clustered specifically around the strong ecosystem, resembling a Scandinavian Silicon Valley, as Odense

aims to become “the world’s best robot city” (Odense Kommune, 2022). However, Elcer points out that the challenge in Odense is the fact that there is a “fight for space”, as it is a smaller area, and that it is not possible to change the infrastructure for the purpose of exclusively designing the city to be smart (Elcer, Appendix 4). Instead, Elcer expresses the opinion that isolated test areas, which there are a few of in Denmark that are either private or on university campuses, would be a better choice of location for a TWC project in Denmark; “it could be super cool to establish a new city area or designate an urban area as they sort of do in “Doll Living Lab” in the Copenhagen area” (ibid.). Looking into the current test sites around Denmark, or establishing a new one, could be worth considering for the choice of location for a TWC project in Denmark, which, by following this approach, would then start out as test-site and over time implement citizens and the city’s infrastructure.

As mentioned in the robotics and AI section of the analysis, Jensen explains that in Denmark, there is a high level of trust and a large pool of person-data available since due to the CPR register, to which she argues that “as a population of almost 6 million, we are actually this smart city because it is fairly easy to make experiments in Denmark” (Jensen, Appendix 2). Therefore, she argues that Denmark is a smart city in itself with “you don’t need to build a city. You have the whole Danish population where you have a good test case for some of these things” (ibid.). Jensen’s aspect views the choice of location for moving the TWC project from Japan to Denmark to be Denmark as a whole due to the interconnectedness and high level of digitalization and digital trust, which is a perspective that views Denmark as an isolated smart city on a country level. Jensen’s argument revolves around scale as “Denmark is a relatively small country and densely populated. This means that the potential for creating new cities where you start all over again may not quite be the same” (ibid.). Scaling a TWC project in Denmark to be the size of the country is an aspect worth considering since Japan is approximately 377,970 km^2 whereas Denmark is approximately 42,920 km^2, which makes Japan about 9 times larger than Denmark, adding 9 times more land to explore the creation of new smart city projects in Japan (WorldData, 2022).

7.3.2 Sustainable construction

The analysis additionally touched upon sustainable construction, which is important to discuss in the relation to the choice of location, where Jacobson explains that when imagining a location for a TWC project in a Danish context, then “framing what your goal with making the smart

city is really important as a starting point" (Jacobson, Appendix 3). Jacobson's explanation is especially interesting as Jacobson is employed in BIG, which makes for a Danish architecture firm leading the developing of the TWC project in Japan, which would then be recreated into a Danish context, recontextualizing the architectural and planning aspect twice (MIC News stream, 2020). Where TWC in Japan was developed with the goal of creating and testing new Toyota technologies, Jacobson argues that in Denmark, it is important to build for the amount of rainfall by using and managing the utilities and infrastructure available and beneficial on the Danish context (ibid.). Visible from earlier analysis, BIG designed TWC in Japan by keeping Japanese sunlight laws in mind and how to implement the aspect of sunlight into the design of the buildings, which are to be build using sustainable, traditional wood joinery (Toyota, 2022). Arguably, the aspect of sustainable construction will be recontextualized into using more reliable and sturdy materials for Denmark, such as bricks which leave a lower carbon footprint and can also withstand the rain and humidity present in the Danish climate (Nielsen, Appendix 7). Sustainability can also be obtained by building in height, which also has the benefit of leaving more soil to sustainable nature.

To this, the source of energy is also an important aspect to discuss to power a TWC project in Denmark. The TWC project in Japan makes use of solar energy, geothermal energy, and hydrogen fuel cell energy (BIG, 2022). When discussing the choice of energy for a TWC project in Denmark, the interview subjects had general positive attitudes towards the implementation of hydrogen fuel cell technology even if that meant implementing fueling stations or storage tanks in the landscape (Jensen, Appendix 2). However, in terms of supportive energy, it was clear from the interview subjects that Denmark should also make use of its natural resources, which would not involve solar and geothermal energy that TWC in Japan does. As Denmark on average has 179 days of rain annually and does not have an existing equivalent to Mt. Fuji in the flat Danish landscape, the supportive energy choices would have to change meanings to apply to Denmark (Danish Rainwear, 2022), Multiple of the interview subjects instead mentioned wind energy as supportive energy to hydrogen to power a TWC project in Denmark, "out natural resource is wind" (Jensen, Appendix 2, p. 11).

7.3.3 Autonomous cars

Even though the expert attitudes show that the meaning of autonomous cars in a Danish context is viewed as positive in terms of sharing vehicles, ease of getting from a to b, and emitting less

CO2, as it was presented in the robotics & AI analysis section it can be argued whether this aspect has ground for isomorphic processes from Japan to Denmark. The legislations for testing new technologies in Denmark is considered “heavy and slow” and the current testing of autonomous vehicles has been at a standstill where experts are even skeptic whether autonomous cars will ever be available for the general public in Denmark. It argues for the fact that a city, which only uses fully autonomous vehicles for the general public serves no ground for isomorphic processes and thus, recontextualization is unable to occur should the TWC project be implemented in Denmark.

As TWC is an entire city, which is tailor-made for testing Toyota’s inventions on human subjects where, on the primary road, only the autonomous vehicles are able to drive, which is designated for heavy vehicles: “optimized for faster autonomous vehicles” (BIG, 2022). This aspect spurs the speculation of whether non-autonomous vehicles can enter the city as well as whether even autonomous but non-Toyota vehicles would be able to drive on the roads within the city. Visitors will be able to get easily from a to b with the usage of the autonomous Toyota e-Palette within the city, however, should non-autonomous, non-Toyota vehicles not be able to drive within the city, it reflects a highly monopolistic behavior from Toyota. Toyota is Japan’s largest car maker, the largest car company globally, and now creating a testbed city for new technologies, which will drive continuous innovation (Johnston, 2020). However, a car manufacturer creating a city where outside vehicles are not able to enter, creates a monopoly environment, which serves no basis for isomorphic processes to the Danish context as the Danish Competition Act is in place (Gersing, 2013). The Danish Competition Act states that the Danish Competition and Consumer authority will intervene when a company “abuses its dominant position”, which would then be the case for TWC (ibid.).

7.3.4 Three-split roads

The three-split roads, where the autonomous vehicles are to drive on the primary road, was argued to have a resemblance to the Danish roads with bicycle lanes and pedestrian sidewalks, which are designated according to the speed and weight of a vehicle, much like the TWC roads. It can thus be argued that the three-split roads are already recontextualized in the Danish city landscapes. However, if strictly sticking to the fact that the thesis investigates the implementation of TWC into the Danish context, where the three-split roads would be moved as a whole, it would arguably not serve as a basis for isomorphic processes as the roads are

already designated. On the other hand, it can be argued that the three-split roads are already recontextualized where this is the new meaning and form, which TWC's three-split roads have taken in the Danish context, which needs to be considered and adapted to gain a competitive advantage.

7.4 Findings

Visualized in figure 11 below, the discussed findings are categorized and depicted according to the type of outcome from recontextualization; negative, positive, undecided, or with no grounds for isomorphic processes:

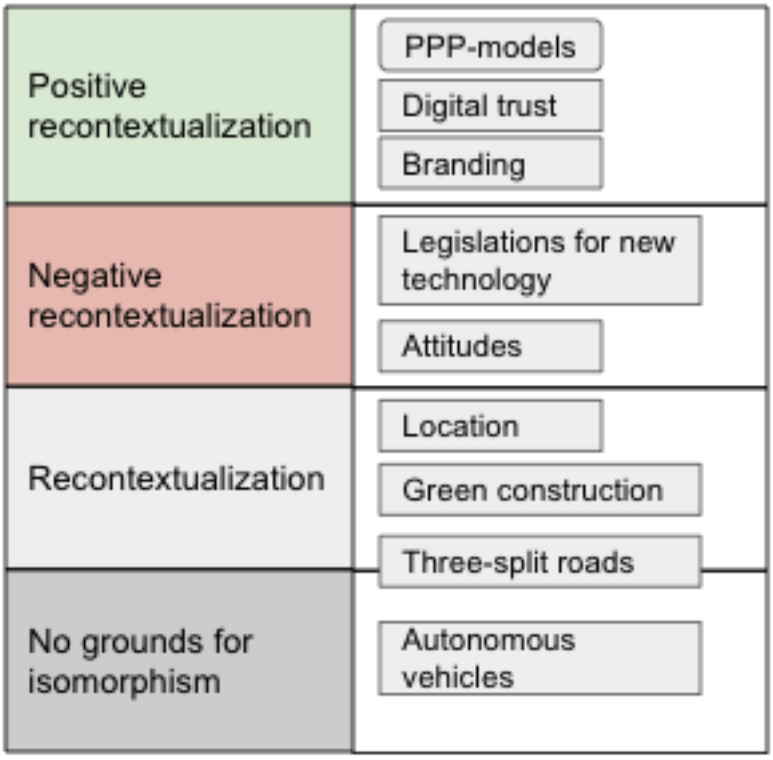


Figure 11. Overview of the considerations categorized in terms of recontextualization for successful implementation of TWC. Source: own depiction, 2022.

The green box consists of the three considerations, PPP-models, digital trust, and branding, which were deemed to have a positive shift in meaning in a Danish context that could lead to opportunities and innovation if followed. The negative box consists of two considerations, legislations and attitudes, which showed a risk of having negative outcomes for implementation of a TWC project in a Danish context, which should therefore be meticulously considered to not become obstacles. The gray box consists of considerations, which simply showed a shift to

a new meaning in a Danish context but were not deemed negative or positive, which were location and construction. The dark gray box consists of considerations, which showed no ground for isomorphic processes, autonomous vehicles, where the three-split roads were argued to be in the middle of the gray and dark gray boxes.

8. Conclusion

To move the TWC project from a Japanese context to a Danish context there are various aspects, which are critical to consider in order to ensure successful project implementation. To move a smart city to a Danish context is not easily done and the TWC project and the new context must be carefully considered to successfully achieve implementation of the project. Meticulousness is critical as there is already an existing infrastructure in the Danish context with national systems, which differ greatly from the ones in Japan.

For moving the TWC project to a Danish context, the project must be performed using a PPP-model and involve more public partners needed than in Japan, where TWC is a privately owned project. A TWC project in Denmark must involve both public and private partners and take the public partners into account in carefully customizing the PPP-model. It is important to take advantage of the strong public-private partnerships, utilize the Danish talent pool, and ecosystem of universities and experts. Furthermore, the Danish legislation process for testing and using emerging technology must also be carefully considered to not become an obstacle as it is slow as opposed to TWC in Japan where Toyota can continually test and implement emerging technology. TWC in Japan is on a much larger scale, where the obstacle in Denmark must be considered in relation to the location of a TWC project in a Danish context. The location should either be evolved step-by-step from a test-site where the aspect of citizens can be implemented when legislations are ready or the Danish national context as a whole should be viewed as a smart city, as Denmark shows a high level of digital trust and digital interconnectedness, creating a benefit for implementation.

It is important to consider the national climate and resources of the Danish context, where TWC in Denmark should be constructed using sturdy materials, such as bricks, where natural resources, such as wind, should be used supportive to hydrogen to power the project sustainably. Considering the Danish population, Danes were expected to show a degree of skepticism towards the aspect of a “living lab” and other emerging technologies from the TWC

project that far from what the population knows, which needs to be considered to not become an obstacle. Considerations to successful branding involve wording, including the sustainability aspect of the smart city, and using things that Danes feel a connection to and know, like TWC in Japan has done by constructing near Mt. Fuji. Instead of implementing autonomous cars and designated streets in Denmark, considerations should instead nudge the usage of shared vehicles, which can be turned into a benefit for the project.

Other national contexts cannot expect the same outcomes when implementing the TWC project into other national contexts. National contexts greatly differ from each other where aspects could be investigated and analyzed to be the same, however, the obstacles and benefits are highly likely to differ according to context, which should meticulously be considered for others to successfully implement a TWC smart city project.

9. Further research

The two omitted levels, professional and individual, were omitted from Clausen's multi-communication model due to the limited access to data and the completion timeline of the TWC project in Japan, where more data is expected to be available on all levels but especially on the professional and individual levels. It could be interesting and add to the research of this thesis to consider the two levels for further investigation regarding the considerations of moving the TWC project to Denmark after the completion and trial of the TWC project in Japan. This study could be performed by interviewing citizens or researchers living in TWC after completion. Additionally, the attitudes towards the implementation of the TWC project in Denmark showed to differ greatly and lean towards skepticism, derived from the expert interviews. It could therefore be interesting to conduct a follow-up study with a larger sample size to investigate whether the Danish population would be as skeptical towards a TWC project in a Danish context as conceived from the expert interviews. To gather a larger sample size, the study could be conducted using surveys with potential citizens for a TWC project in Denmark.

Creating the thesis and conducting research on moving the TWC project from the Japanese national context to the Danish, spurs the interest of ´whether there are considerations that would be the same for all national contexts globally, in relation to creating smart city "living labs". Since smart city solutions and systems are being developed in existing cities by a step-by-step approach or developed as new cities, it could be interesting to investigate whether there are

considerations which reoccur across national contexts globally to make the process quicker and easier. This investigation would be a much larger study. However, the thesis findings spur the interest of whether there are certain considerations, which would be the same across contexts globally when implementing smart city "living labs" to create a general guidebook of dos and don'ts.

The results of the thesis can be used to guide professionals in which considerations are important for implementing a smart city in the Danish landscape and aspects on how to maneuver them or the thesis can serve as a platform for other scholars to further investigate the objective of implementing a smart city in Denmark.

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