



Skellefteå 2050

Project Report

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Sustainability Transitions in Skellefteå by 2050

Julia Berglund, Priyadarshini Karthikeyan, Olof Nordling, Michelle Silva Vásquez & Rishabh Varma

Executive Summary

Cities worldwide are facing complex challenges as they seek to undergo sustainability transitions. The city of Skellefteå in the north of Sweden is currently driving a huge transformation to become a more sustainable and attractive city by 2050. However, the challenge of ensuring a stable competence supply for the sustainable development of the city will need to be addressed. Based on a systemic approach and considering the Municipality's objectives, a future vision has been defined to overcome this challenge:

Skellefteå - A vibrant and culturally diverse Northern hotspot of cutting-edge education in sustainable development, that is thriving in harmony with nature.

Educational and cultural aspects have been highlighted in the future vision, as we believe, they are the most relevant and impactful aspects when addressing the concern about the attractiveness of the city, having young professionals as the main target group. To achieve this future vision, a combination of two possible solutions has been suggested:

- *Innoversity*, a disruptive educational center that intends to utilise technological developments and innovation to optimise learning and promote cooperation between institutions, companies, and the municipality. It will serve the purpose of attracting the young competent people required for the development of the local industry and the city.
- *Bonnstan 2.0*, a cultural district in the surroundings of the current Campus with modern restaurants, cafes, bars, and art-related venues. This place will integrate culture and entertainment in urban planning to ensure that Skellefteå will be an attractive place for people of all backgrounds. It will combine the local culture with the global diversity in a contemporary and creative ambiance.

To move forward in this direction, a pathway, and a starting point with five feasible experiments have been suggested: A Hackathon; An Academia-Industry workshop; A Campus Design Competition; A Cultural Business Workshops; and an Innovation Hub.

Although we cannot predict the future, we can all be involved in creating it. The innovative process to drive this transition will have to take place across multiple levels, involving a range of actors and sectors simultaneously. Many inspiring and ambitious projects are already underway in Skellefteå. Therefore, this study can serve as inspiration for further discussions towards the development of Skellefteå.



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1. Introduction

Skellefteå is a town in the region of Västerbotten, situated in the north of Sweden close to the arctic circle. The municipality is home to around 73.000 people, and about half live in the town of Skellefteå. Geographically, it is Sweden's largest coastal municipality. Sustainability is at the core of the growth and development of the municipality. Skellefteå is participating in the initiative 'Climate Neutral Cities 2030' within the Viable Cities innovation programme and has thereby set the goal to be climate neutral by 2030. In 2016, Northvolt started building a battery gigafactory in Skellefteå that will produce the greenest batteries, marking a new chapter in European industrial history. This gigafactory will design, manufacture, and assemble green lithium-ion batteries in house and because of this, it will employ around 3.000 employees with specialised competence in the field.

With this establishment, the municipality expects a surge in population as well as an expansion of all job sectors and wants to use this opportunity as a springboard to transform Skellefteå as a motor for innovation and sustainable development. The vision of Skellefteå is to be "A sustainable place for a better everyday life", and in the strategy to reach that, four main areas have been identified: 1) A sustainable and diverse environment, 2) Knowledge and unique competence, 3) Globally competitive economy, and 4) Overcoming distance (Skellefteå kommun, 2022). It has been addressed by the municipality to increase the attraction work, focusing on competence supply and migration, to meet the needs of the job market in the coming years. Also, it has been identified to keep in mind that there could be a risk of focusing on the urgent needs of the industry. To tackle this, the municipality, SMEs, and industry should prepare and plan at a larger scale to avoid eroding some industries and public services of competence (Skellefteå kommun, 2021). Considering this, the focus of this project is to explore the future of competence supply and the attractiveness of the municipality, addressing a combination of objectives in the first three main areas.

1.1 Aim and Objectives

This project aims at supporting Skellefteå municipality's transition towards a more sustainable and attractive city by 2050, focusing on the educational and cultural aspects. The objectives to be achieved through the application of the Participatory Backcasting (PB) framework are as follows:

- To identify the major challenges and define a vision for system transformation.
- To provide solutions and pathways towards the city's transition.
- To integrate the knowledge and insights of different stakeholders and actors in the development of the proposal.

2. Methods

To achieve the aim and objectives of the study, the modular Participatory Backcasting (mPB) framework was used as a guideline. This method was developed in 2019 and can be used to analyse current scenarios and design visions for the future (Kordas et al., 2019b). The mPB framework can be divided into different focus areas, consisting of analysis of the problem, development of a vision, design of criteria and solutions, and a proposed pathway to achieve the vision. The work process was thus divided into 13 different modules, based on the proposed pathway of the mPB framework (Kordas et al., 2019b).

As the focus of the study was Skellefteå Municipality, initial data collection was made about the current situation to create a foundation for further analysis. In addition, relevant concepts and theories regarding system innovation were studied. The information was obtained from publicly available sources, which included general statistics of the demography and the ongoing projects in Skellefteå. Due to the geographical position of Skellefteå, google street

view was used to get an overview of the design of the city. Furthermore, representatives from Skellefteå municipality were invited to present their perspectives of the situation and later interviewed during a groupal Q&A session, to collect specific information regarding the ongoing work in the municipality. A varied type of data sources has been used, ranging from video content published by the municipality to scientific papers, to get a broader input. Throughout the study, the work process consisted of joint collaborations and discussions, where the collected information was used as a starting point. Each module in the mPB framework was then completed by reaching consensus within the group based on the available information.

3. Results

This chapter will describe the outcomes of every module in the mPB method. The outcomes will be described with supporting data collection and our analysis.

3.1 Problem Orientation

Skellefteå is rapidly expanding, and with this many challenges arise. Two key aspects that have been highlighted are competence supply and people moving in from other parts of the country or from abroad. Therefore, one of the major challenges is to be an attractive municipality that can ensure a stable competence supply needed for the sustainable development of the municipality.

“Ensuring competence supply by being an attractive municipality with globally competitive opportunities for a sustainable future”

Historically, the municipality has a high employment rate, which means that the local workforce reserves are scarce. The emigration rate of young people has also been high for many years, resulting in an ageing population structure. Additionally, there is an ongoing generation shift in the job market, with rapidly increasing retirement rates within several industries (Skellefteå kommun, 2012). Before, the competence that was needed could be recruited locally with high success. However, in the future, all kinds of competences are needed in Skellefteå, and currently the need for more industrial workers and engineers are specifically urgent, according to a local recruiting company and Northvolt. Therefore, Skellefteå is now dependent on people moving in – and settling down – to meet the increasing demand of employees from the expanding industries and society. (Näringslivskontoret Skellefteå kommun, 2021)

The establishment of Northvolt has certainly contributed to the recognition of Skellefteå globally, and local actors have noticed an increased interest in the municipality. An upcoming challenge will be to combine the expansion of the urban areas, industries, and service – creating a small but vibrant global city – while also preserving and promoting the local culture, atmosphere, and lifestyle (Näringslivskontoret Skellefteå kommun, 2021). Focusing on an attractive place branding and long-term recruitments is crucial to attract people who want to settle down, preventing a pattern of “fly-in, fly-out”. An increased variation of culture, entertainment and recreation opportunities has also been mentioned as essential to keep the municipality an attractive place to live and enhance global competitiveness. However, Skellefteå is also considered as a place for a “simple lifestyle”, which is something current residents appreciate and could be regarded as central in the identity of the city (Näringslivskontoret Skellefteå kommun, 2021; Visit Skellefteå, 2022).

Many companies struggle to recruit employees with higher education, even if statistics show that there is a rising number of people with higher education in the municipality. Northvolt is expressing that one of their strategies for recruitment is to search for similar competences in declining industries, for example fossil fuel industries. Several actors emphasise that collaboration is crucial, not only for more efficient and successful recruitments, but also to avoid taking employees from each other within the municipality, shifting the burden of the problem to someone else (Näringslivskontoret Skellefteå kommun, 2021) The European commission has addressed that Europe has a growing potential for battery production and related industries, but the education and competence is lacking. From

Campus Skellefteå's point of view, up-skilling and re-skilling is crucial to address the current competence needs but also to secure the future competence in key industries. In summary, along with a more advanced local economy, the need for large-scale competence transformation is huge and urgent. (Näringslivskontoret Skellefteå kommun, 2020) (Näringslivskontoret Skellefteå, 2021b).

3.2 System Boundaries

The project is geographically limited to Skellefteå. Furthermore, the time is limited to 2050, and the targets of 2030 to be achieved by Skellefteå are considered as the milestones. The project has a multi-level perspective where stakeholders and actors are considered. The present and the future stakeholders are considered in the vision 2050. It is also assumed Skellefteå will have the same geographical and political boundaries in 2050 as in 2022. The socio-technical system has the goal of integrating the social needs with the technical needs required to achieve the main challenges of the system. The system focuses on both social as well as the technological aspects and joint optimization of the system (Fox, 1995). The system was defined to study the education and culture sectors in Skellefteå municipality, as seen in Figure 1, to address the competence supply and city attractiveness. Within the system boundaries, the central actors and elements of the societal functions were defined. These boundaries were set to focus the exploration of this topic on how Skellefteå can continuously attract young adults to relocate, ensuring a stable competence supply and satisfied residents in future.

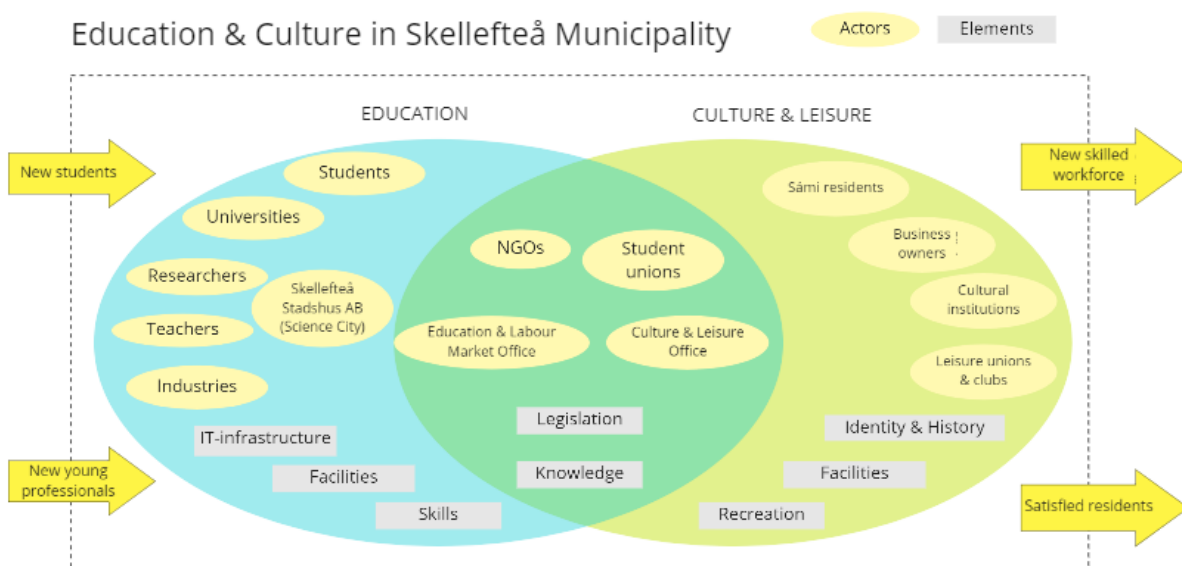


Figure 1. An overview of the Socio-technical Systems and System Boundaries.

3.3 Current Situation Analysis

To develop an understanding of the system in focus, an analysis was made of the current situation in Skellefteå. The inputs were obtained by collecting data from online sources, and were also verified through Q&A sessions of representatives from Skellefteå Municipality. Skellefteå is today mainly characterised by its large industries, such as mining, wood industry and the newly established battery factory Northvolt. Compared with other municipalities in Sweden, unemployment in Skellefteå is relatively low, and today the mining company Boliden is the municipality's largest employer (ekonomifakta, 2021). The labour market landscape is expected to change with the establishment of Northvolt, as they plan to hire up to 3,000 new people in the coming years (Teknikföretagen, 2020). In addition to the large, well-established industries in Skellefteå, new companies are emerging. Today, the municipality is at the forefront of IT and game development in Sweden. Through collaborations between other neighbouring municipalities, this industry is constantly evolving, which is reflected in the annual gaming festival Nordsken (Campus Skellefteå, 2022).

The demand for new employees in Skellefteå has caused an employee-driven market, where the growth of the municipality relies on a continuous attraction of new people. The establishment of Northvolt has contributed to a favourable climate for other types of industries and workplaces, which potentially can create reinforcing loops in the future. An example of this effect is the newly established Korean company Dongjin, which has signed an agreement with Northvolt where they will supply materials to the battery factory (Skellefteå kommun, 2021a). The abundance of green and reliable energy from the local energy company Skellefteå Kraft, has contributed with stability for the industries in the regions. Skellefteå Kraft is completely owned by the municipality, and one of Sweden's largest producers of electricity. Reliable and accessible energy has been a critical factor of the recent establishment of new industries (Skellefteå Kraft, 2021).

The availability and variation of higher education is limited, but it is possible to study at Skellefteå Campus through collaborations between the nearby universities in Luleå and Umeå, as well as Mälardalen University (Skellefteå kommun, 2021b). The courses and programs that Skellefteå Campus offers are characterised by the local businesses, and include programs related to the wood industry and game development. In addition to these more traditional programs, Skellefteå Campus has also adopted more innovative forms of teaching. One initiative is the so-called Massive Open Online Courses (MOOC), which are open and free online courses that are available for everyone to attend (Skellefteå Campus, 2022).

Although Skellefteå is a small town, several projects are underway regarding the development of the culture and entertainment industry. An example of this work is Sara Kulturhus, which is in the city centre and was completed in 2021. This unique wooden building offers a variety of cultural experiences and events, and includes a hotel, restaurants, and a library (Sara kulturhus, 2021). The construction of wooden buildings is a well-known landmark for Skellefteå and attracts interest from all around the world. In addition, the handling and processing of wood has placed Skellefteå at the forefront in this sector. Through collaborations with research institutions and world-leading expertise, this industry contributes to the transition towards a sustainable future (Klimatkommunerna, 2021).

In addition, various actors within the municipality are working together to develop collaboration between different sectors and industries, such as Skellefteå Science City and the Arctic Center of Energy Technology. Skellefteå Science City aims to promote cooperation and innovation in the city, by attracting new companies and making it easier for existing actors to grow and collaborate (Skellefteå Science City, 2020). Arctic Center of Energy Technology is one of many projects established within the municipality, where the focus is on developing and providing the industries with skilled expertise. In addition to Skellefteå Municipality, the education and research institutions Luleå University of Technology and RISE Research Institutes of Sweden are involved in this project, as well as the newly established Northvolt (Skellefteå kommun, 2020).

3.4 Stakeholder Analysis

Bryson (2004) defines stakeholder as “any group, or individual who can affect or is affected by the achievements of the organisation’s objectives”. According to Freeman et al. (2010), stakeholder analysis is important as it addresses three interconnected problems: 1) understanding the dynamics of how value is created and traded, 2) the balance between ethics and capitalism, and 3) Helping managers plan about management of the first two problems. The first step for choosing stakeholder participants is the power vs interest grid. This step is important as it can help Skellefteå Municipality assess the idea creation process strategically and the coalitions required to reach a successful conclusion (Bryson, 2004). Based on this, a power vs interest grid was formed, and five most influential stakeholders were selected. To do that the involved actors were classified based on power, interest, roles, and other characteristics. The selected stakeholder groups were: Municipality, Industry, Researchers & Academia, Citizens, and Future citizens.

Municipality

The planning and development of the sustainability transition in Skellefteå by 2050 is being led by the local authority (municipality). Therefore, Skellefteå Municipality is the main governmental stakeholder of this study. As this project addresses the increasing demand of competence supply and city attraction, the municipality is a crucial

enabler in the ongoing societal transition. Based on the Multi-Actor Perspective presented by Avelino and Wittmayer (2016), the local municipality can be categorised in the state sector and as a public, non for profit, and formal stakeholder. Regarding the level of power, local authorities in Sweden have a considerable degree of autonomy as well as independent powers of taxation (SKL, 2020), which increases the influence of the Municipality. Therefore, Skellefteå municipality ranks very high in the power and interest grid.

The Skellefteå municipality consists of various bodies and should therefore not be considered as one entity. There are departments of the municipality that are more invested in the sustainability transition in Skellefteå, and the offices with highest interest in this project are highlighted in green in Figure 2 below. Figure 2 shows the overall organisational structure of Skellefteå municipality.

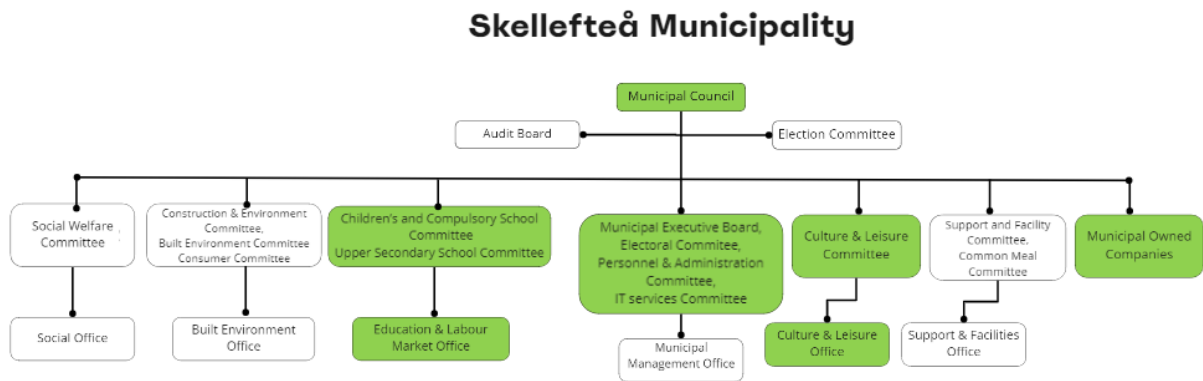


Figure 2. An overview of the organisational structure of Skellefteå municipality.

Industry

The economic prosperity of an area is largely dependent on the industries that flourish there. Hence, industry becomes an important stakeholder group that may be affected by any type of transitions and could also be drivers of transitions. There are various industries working on multiple levels and capacity and all of them do not have the same power and interest for the sustainability transition in Skellefteå. An analysis of all major industries was done, and the most influential players were found to be Northvolt (electrification and battery industry), the wood industry, the gaming industry, and Boliden (mining industry).

The current role of Northvolt is to produce batteries for the automotive sector and for energy storage. In addition, Northvolt will play a key role in offering jobs in the municipality. Currently, they employ 100 new people every month and in the long-term plan to employ 3,000 people in total (Bergström, 2021). Therefore, Northvolt's role in Skellefteå can be assumed to continuously expand in the future, giving them a significant influence in the municipality, by providing job opportunities to many people. As Northvolt is a private company, the organisation can be described as a formal structure with a focus on profit (Avelino and Wittmayer, 2015). In addition, the municipality is both an investor and a partner in the company, which further strengthens Northvolt's power as a key actor in Skellefteå. The wood industry in Skellefteå is also very prominent because of the 480,000 hectares of forest, and the adopted wood construction strategy (Wainwright, 2021). Most buildings like apartments, schools, and multi-storey car parks are built using wood. Even the bridges, the air traffic control tower, and hotels are built using wood (Wainwright, 2021).

Researchers and Academia

Researcher as a stakeholder can be an individual, research group or a research institute. Academia/ Research institutes are contributing to the sustainable transition through research, competence, and power to inform and guide other stakeholders. The researchers working on the sustainable transition have informal power. They choose to participate in the research, go through various perspectives, take in account the other stakeholder point of view and engage in self-reflective practices with respect to their power in sustainable transition research (Wittmayer and Schöpke, 2014). The researchers aim to emphasise initiatives to sustainable transition of Skellefteå by 2050. The researchers in various organisations work on the different fields to achieve the target of Sustainable transition

Skellefteå 2030. The role of researchers and academia is important in this context to enhance and develop a stable competence supply achieved by higher education.

Citizens

Citizens play a key role in the future development of the municipality, as they inhabit key roles for the society to function. They are also affected by the societal transition with increased population growth, changing housing market conditions and increasing opportunities. For this project, young adult residents were identified as important actors in the general group of citizens, as they are the main targets for the future development, hence it is pertinent to take their point of views into consideration. The nature of power of young adult residents could be described as informal, private, and non-profit in a community setting, on the level of individual actors. However, individual actors can inhabit different types of roles (Avelino & Wittmayer, 2016). Even if their collective role is residents, they might have other individual roles such as employees, students, consumers, voters, volunteers etc. Cities and societies are meant to be built for the people living there, therefore, it is crucial to involve their active participation in the development to address their future needs and interests.

Future Citizens

The sustainability goals of Skellefteå involve increasing the competence supply to accommodate the demands of the industry and society. Hence, the future citizens of Skellefteå are an important actor, and their concerns should be considered. (Skellefteå municipality, 2022). Future citizens could also be defined as private, informal, and non-profit, being a part of the community (Avelino & Wittmayer, 2016). For the sustainability transitions of Skellefteå, the municipality is dependent on people moving in, and the future citizens need to uproot their current life and relocate. To attract people to relocate somewhere, possibly very far away, the needs of the future citizens must be facilitated. It is also essential to define certain target groups and focus on promoting the lifestyle and the specific opportunities of Skellefteå. Moving is a significant step, and they have interests to consider making this transition (Knight, 2018). It is expected that most of the future citizens will be 25 to 35 years; hence, they will be a young family or plan to start a family soon. Therefore, their needs and interests will address many aspects of the municipality, such as job opportunities, social and recreational opportunities, and societal services, such as kindergartens, schools, and healthcare (Poggenpoel et al., 2022).

Relationships between stakeholders

According to Freeman (1994), a stakeholder analysis has two competing interpretations: The strategic interpretation and the multi-fiduciary interpretation. The strategic interpretation states that managing stakeholders is merely a means for achieving stockholder and managerial ends. Hence, managing stakeholder relationships is good as it allows the managers to fulfil its objective of maximising its profits. The multi-fiduciary interpretation states that the managers have a fiduciary responsibility towards stakeholders and managing stakeholder relationship is non-optional (Freeman, 1994). Both the interpretations of stakeholder analysis focus on defining the relationship between stakeholders. For economic, social, and environmental sustainability of Skellefteå in the long run, it is important that the multi-fiduciary interpretation is considered instead of strategic interpretation. Figure 3 shows the relationship between various stakeholders.

To explain the relationships shown between the stakeholders, an example is provided. Ever since the start, Northvolt has worked closely with Skellefteå municipality and their energy company Skellefteå kraft. The municipality has contributed with land, energy and fibre connection, which has facilitated and accelerated Northvolt's establishment. In addition, Skellefteå Kraft has joined as a partner in the company (Skellefteå Kraft, 2021.). Hence, the relationship depicted in Figure 3 between industry and municipality. Similarly, the other relationships pictured where drawn, however, a more in-depth analysis of the different relationships and dependencies would be needed. This only illustrates the interconnectivity of stakeholders, stressing the importance of collaboration to have a successful and efficient municipal development.



Figure 3. An overview of the relationship between various stakeholders.

Stakeholder participation

To get more insights on the stance of various stakeholders and gather more data, engagement with individuals representing stakeholder groups were performed. It is important to understand the motivations and reservations that stakeholders have about the sustainability transitions in Skellefteå, which can be achieved by stakeholder participation. As students studying in relevant fields for the local industry to attract, outside Skellefteå are potential future citizens. Hence, multiple students were interviewed in a casual setting and their feedback was considered in the process of designing the solutions for Skellefteå 2050. The perspective of Skellefteå municipality was gained by initial engagement by presentations by the municipality providing general insights and were later deepened by Q&A sessions and some contact by email. A current citizen of Skellefteå, relocated from Belgium, working at Northvolt was approached and an in-person meeting was conducted to understand the needs and challenges of current citizens that have recently relocated. However, the stakeholder participation is something that would be crucial to increase if this project was about to be further explored, which is discussed later in the *Limitations and recommendations for further exploration*.

3.5 Needs and System Functions

Based on the main challenge identified in the current situation about how to become an attractive city for many more people willing to move into Skellefteå, we defined *education* and *culture and leisure* as the societal functions provided by the city that are more associated with this issue. We believe these aspects are the most relevant and impactful when addressing the concern about the attractiveness of this city, especially when the main target group is young professionals. Therefore, our system configuration is based on the interrelations among the elements and actors related to these two functions.

Figure 4 shows that regarding education, its major function in society is to facilitate the acquisition of knowledge and competence (OECD, 2018). As we have seen previously, Skellefteå has a Campus and other important educational facilities such as Science City. Besides, the Municipality is currently working on more than 15 projects with different stakeholders. However, it needs to go further to fulfil the demands of the future. The current needs behind the system configuration in terms of education can be divided into quality and relevance. First, it is essential for the growth of the city to not only expand the infrastructure and facilities within the current Campus but to also

develop its own educational centre. Besides, a more variety of higher education – especially technical and engineering programs – and courses, with a focus on sustainability matters is required. The development of research and the implementation of modern technology and innovative spaces is also crucial for transforming the educational system in the city.

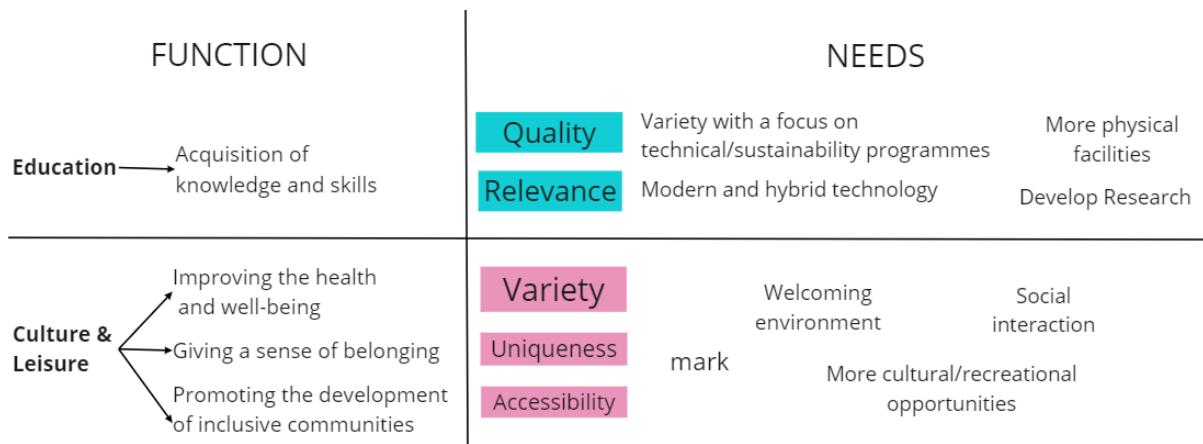


Figure 4. An overview of the identified needs and functions.

With respect to culture and leisure, its main functions are to improve the health and well-being of the citizens, to give a sense of belonging and to promote the development of more inclusive communities (Torjman, 2004). The needs regarding this function are about having a high variety and accessibility of cultural and recreational facilities, with a special focus on indoor activities without neglecting the enjoyment of green areas and nature. Efforts for developing more lively environments and nightlife are also essential elements to attract youth. Furthermore, it is crucial to promote social interaction and cohesion among current and future residents with the establishment and support of leisure and social clubs as well as actions to welcome new residents. Lastly, it is important to take advantage of the uniqueness of the city to create a mark by which Skellefteå can be recognized at regional and global scales. Cultural traits such as the love of nature and valuing a simple lifestyle, plus traditions related to the Sámi ethnic group, are key elements to consider.

3.6 Future Vision

Creating a future vision for Skellefteå, it was emphasised on what is already expressed by Skellefteå municipality (2022) regarding visions, objectives, and general sustainability goals. The vision was aiming to highlight current characteristics and add a new component that could enhance the development. The vision is centred around the challenge of being a globally competitive and attractive place to live for young talent with desired competence. At the same time highlighting social cohesion, sustainability, and environmental resilience.

Skellefteå - A vibrant and culturally diverse Northern hotspot of cutting-edge education in sustainable development, that is thriving in harmony with nature.

With a clear vision of a city, leaders can make conscious decisions to create an attractive city. There is often a focus on what type of business or industries that are desired to attract, but it could also be suggested to focus on what type of people to attract instead. After all, it is the people who make the city prosperous and welcoming. By focusing on which demographic group that are key targets, the city can plan accordingly. To create a successful vision and plan for it, it is important to involve targeted stakeholders and to have a comprehensive view, covering everything within the boundaries of the city or municipality (KPMG, 2016). However, as described by Neuvonena & Acheb (2017) several visions could be combined and further worked on to elaborate something including more aspects, which was the case of the Helsinki vision for 2050. This vision could also be elaborated, including more comprehensiveness, by being combined or connected with other visions and engaging more stakeholders.

The city identity can reflect values, skills, and interest of the residents, and focusing on that is one way to envision what groups the city wants to attract. A clear identity can be a great tool to communicate what the special features are of a place and be a guidance for people considering relocating. By offering good quality of life and providing services that the target group desires, the identity of a place can incrementally transform. For example, Malmö has transformed from being an industrial city with an ageing population to an attractive city for young entrepreneurs in sustainable technology (KPMG, 2016). Oulu was once the heart of Nokia and when the company collapsed the city experienced a drastic change. However, the high competence of radio signal engineering of all the former employees could be combined with another leading industry there, life science and health care research. By combining these, Oulu showed to be surprisingly resilient and became a centre for digital health (O'Brien, 2019). Both these examples are stressing the importance of the residents and their skills.

3.7 Criteria

The criteria have been created in accordance with the formulated vision, dividing the vision into three goals: Vibrant and culturally diverse; In harmony with nature; and Cutting-edge education in sustainable development, as seen in Figure 5. To find appropriate indicators, or sub-criteria, and how these could be measured, inspiration from the municipality development strategy, other projects and indexes has been used. For example, the indicators used in Stockholm Royal Seaport, innovation indexes, educational indexes and similar.

Goals	Criteria	Relative Weight	Sub-Criteria	How to measure
Vibrant and culturally diverse	1 <i>Vibrant</i>	0,20	Attractive outdoor environment	Number of facilities to enjoy nature and green areas
			Variety of cultural/recreational opportunities	Number of different types of cultural/recreational opportunities
	2 <i>Inclusive & Diverse</i>	0,15	Accessibility to cultural & recreational activities	Satisfaction rate of access to cultural and recreational activities.
			Contribution to a welcoming environment	Number of actions to welcome new residents
In harmony with nature	3 <i>Sustainable</i>	0,20	Promotion of environmental sustainability	Education: Number of sustainability courses Culture: Number of sustainability initiatives
			Sustainability Impact	Level of impact of potential sustainability projects
			Green infrastructure	% of sustainable construction material used Sustainable management (e.g energy efficiency, renewable energy, low maintenance)
Cutting-edge education in sustainable development	4 <i>Innovative</i>	0,15	Innovation potential	Innovative capacity and outputs <ul style="list-style-type: none"> • Education: e.g. number of patents • Culture:
			Availability of latest technology	Access rate to high quality technical infrastructure and software
	5 <i>Valuable & Relevant</i>	0,30	Research contribution	Produced papers/year
			Education quality	Teaching, content
			Global recognition	Academic international rankings

Figure 5. An overview of the selected criteria.

3.8 Driver Analysis

With the input from the developed vision and the identified criteria, an analysis was made of future driving factors to create a foundation for the development of future solutions (Kordas et al., 2019a). Through collaboration and discussions, drivers were identified and organised according to their potential impact and their degree of uncertainty. The information that was collected was then arranged together into an impact-uncertainty grid, to get a better overview of the different drivers. Based on this analysis, two different categories of future driving factors could be identified, namely trends and key uncertainties, as seen in Figure 6. Although low and high uncertainties were both considered, drivers classified as low impact factors were not taken into account, as they will not affect the future to any great extent.

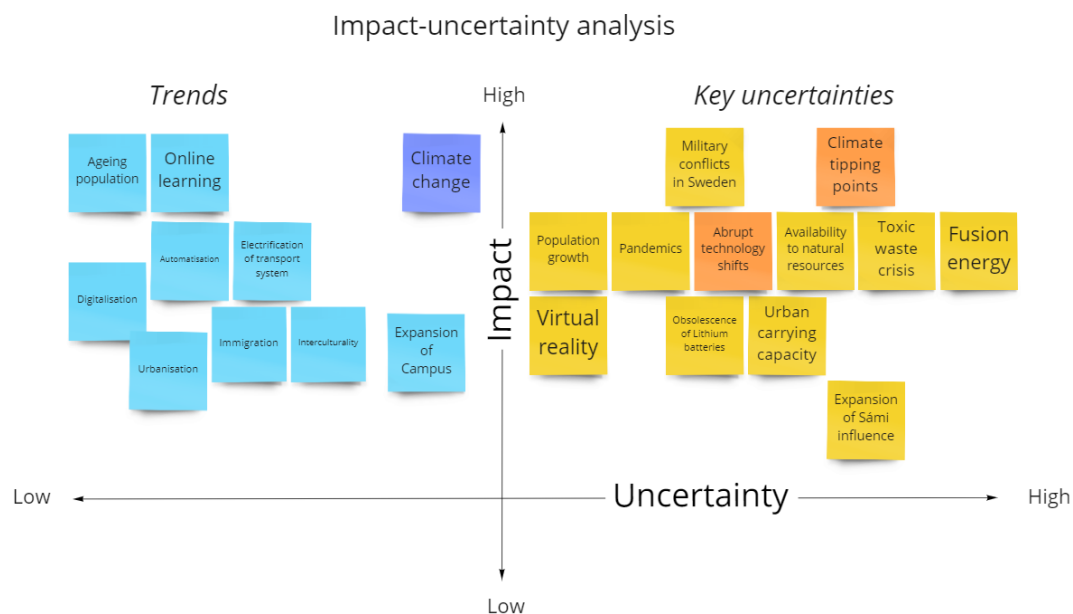


Figure 6. An overview of the impact-uncertainty analysis.

Trends were defined as factors with a large impact and a high probability that they will occur. Examples of these trends are ongoing shifts such as urbanisation, digitalisation, and ageing population. Key uncertainties were also defined as factors with a potentially large impact, but with greater uncertainty of occurring in the future. These factors have the potential to radically change the current systems in society and can for example be abrupt technology shifts or instability due to climate change. To develop an understanding of the different future scenarios in Skellefteå municipality, two of these key uncertainties were selected and combined to identify four possible scenarios. These two factors were climate change and technological shift, which are two external factors that Skellefteå Municipality has little opportunity to influence. Thus, the future could be divided into a stable, innovative, collapsing, or adapted scenario, as shown in Figure 7 below.

The Stable Scenario is characterised by steady climate change and incremental technological shift. This would lead to a future of prosperity, where current industries continue to be successful, and the future feels secure and predictable. The Innovative Scenario is characterised by steady climate change and radical technological shift. This future would lead to a prosperous Skellefteå, where new innovations and start-ups contribute to an attractive municipality. At the same time, radical technological shifts will potentially change the current systems in society, which contributes to instability and uncertainty for the already established industries and institutions. The Collapsing Scenario is characterised by dramatic climate change and incremental technological shift. During this scenario, technological developments will not be able to mitigate the effects of climate change, which will eventually lead to an economic depression in the region. Therefore, natural resources will slowly be depleted and the carrying capacity will be exceeded, which has the potential to create large numbers of climate refugees. The Adaptive Scenario is characterised by dramatic climate change and radical technological shift. This future will be unpredictable and uncertain, but new radical innovations may allow for adaptation. As the municipality undergoes large-scale system changes, it opens the possibility for new technologies and solutions to emerge.

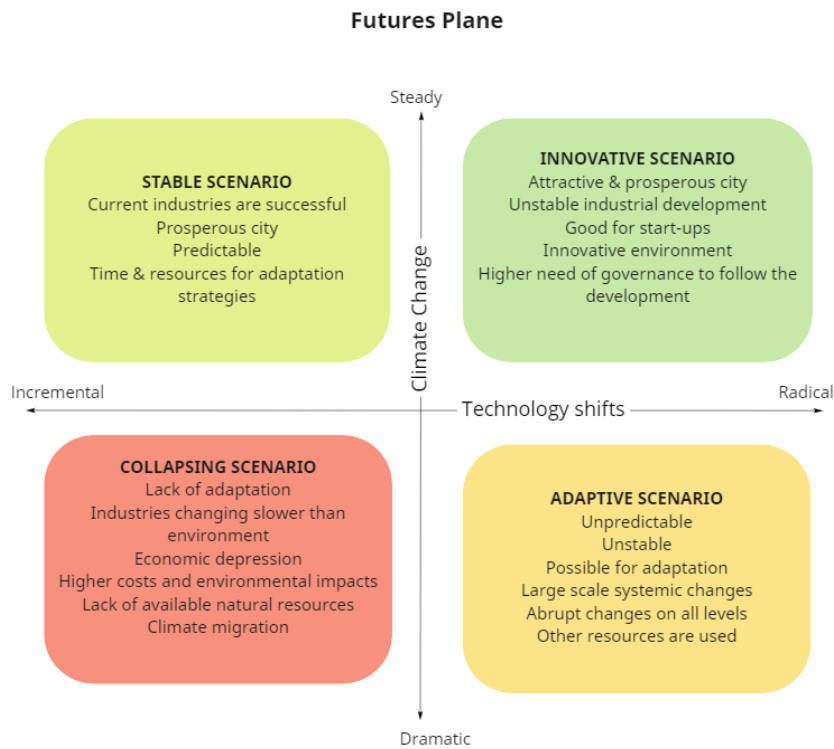


Figure 7. An overview of potential future states in Skellefteå Municipality

3.9 Internal Scenarios/Solutions

Internal scenarios are the possible solutions which are framed from different combinations of dimensions which can be included in the socio-technical system. The morphological method was used for scenario development, including state and dimension selection. The method comprises five steps: identification of dimensions, identification of states, creating a morphological table and selection of scenarios for further in-depth analysis (Pereverza et al., 2017) The dimensions identified for the system are divided for education, culture and leisure and the dimensions common for both the systems. The dimensions are level of physical education, time duration for education, social activities, technology usage, recreation, and accessibility of entertainment. Based on the requirement to strengthen the functions, the state of dimensions is given. Figure 8 gives a clear idea about the dimensions and the states of dimensions.

	No	Dimensions	States of the dimensions		
Education	1	Level of physical education	High	Medium	Low
	2	Time duration for education	3 + years	1+ years	Less than 1 year
Culture	3	Social activities	Diverse (cross-boundary)	Mixed	Specialized
	4	Usage of technology	High	Medium	Low
	5	Recreation activities	Indoor	Mixed	Outdoor
	6	Accessibility of entertainment	Close	Far	Outside the municipality

Figure 8. Morphological table with the dimensions and the states of the system.

The morphological table was mainly used for inspiration to come up with different types of solutions. Following are four possible internal scenarios described, taking these dimensions into consideration.

Solution A: Skellefteå Learning Center

Skellefteå Campus currently provides higher education in collaboration with other institutions and universities. The first solution is to establish the Skellefteå Learning Center. The traditional education system could be altered, and a more diverse system could be implemented. Currently, Campus Skellefteå has programs related to wood technology, gaming technology, power engineering and mining, and in future the university can also introduce programs and courses relevant to sustainable energy and renewable energy. Some short courses can be provided to the students interested in various other fields of technology. By expanding the campus and university, research works can be prioritised with collaboration with other research institutes such as R.I.S.E, this will encourage students. The Learning Centres with a good environment and interesting courses can attract young students to migrate to Skellefteå for education, which will pave the way for Skellefteå to become an educational hotspot.

Solution B: Innovation Hub

Skellefteå Innovation hub can be a business incubator and could be seen as an extension of the current Skellefteå Science City. The innovation hub can support idea bearers, researchers, innovators, and entrepreneurs. The hub can help and guide start-ups, entrepreneurs in development and help in growth of companies to reach international markets. On supporting the companies, start-ups, and entrepreneurs the job opportunities increase which makes young professionals move to Skellefteå. The innovation hub will also make researchers, research students to work and collaborate with other companies.

Solution C: Indoor Recreation Center

To address the cold and long winters, combining it with the access of renewable energy, an indoor recreational center could possibly be appreciated by residents that are not well adapted to the climate, as well as anyone who is tired of walking around in many layers and still freezing. The vision would be just like a giant greenhouse, like a public indoor park. The recreation center would also be designed and equipped with sports activities and leisure activities, maybe a museum, botanical garden, or a community farm. Setting up an Indoor Recreation Center in Skellefteå could help to increase mental and physical health, especially in the darkest months as the center could also be equipped with UV-light or “sun-rooms”. The center could offer many activities and sports and serve as a place to socialise among people.

Solution D: Bonnstan 2.0

The old Bonnstan was built to meet church obligations, but also became an important social meeting point for people living in the surrounding area (Visit Skellefteå, 2022). There probably used to be several, secret pubs, and a marketplace where residents and visitors could trade goods, socialise, make contacts, and possibly have romantic meetings too (Visit Skellefteå, 2022). To connect with the historical meeting point and keep the essence of the city, we choose this name for the suggested solution. Bonnstan 2.0 is a place where a variety of entertainment venues can be established but keep the local character of small wooden houses. Bonnstan 2.0 can serve as a gathering spot for existing as well as the potential residents. The place helps in socialising people along with nature, it can become an attractive spot not only for students but for all the residents interested in moving to Skellefteå.

3.10 Scenario Testing

After defining a set of alternatives to tackle the selected challenge, they were evaluated in terms of the decision criteria defined for each of the vision goals. As we presented previously, four different choices of action were proposed, two focused on education and the other two on culture. To evaluate the proposed solutions, the criteria was organised in a hierarchical structure, with 5 major attributes, each of them associated with 2 or 3 sub-criteria, as seen in Table 1. Under the presence of Multi-Criteria Decision Making (or MCDM), it is normally required to

assign weights of importance to each of the attributes, adding together up to one (Triantaphyllou et al., 1998). Table 1 shows the relative weights (RW) assigned to each of the five criteria, being 0.20 for vibrant environment, 0.15 for inclusive & diverse, 0,20 for sustainability, 0.15 for innovation and 0.30 for valuable & relevant.

Sub-Criteria		RW	A. Skellefteå University	B. Innovation Hub	C. Indoor Rec. Center	D. Bonnstan 2.0
1	Vibrant Environment	0,20	2,0	1,5	4,0	4,0
1.1	Attractive Outdoor		3	1	4	3
1.2	Variety		1	2	4	5
2	Inclusive & Diverse	0,15	3,7	3,0	4,7	4,3
2.1	Accessability		2	2	5	5
2.2	Welcoming Environment		4	3	4	4
2.3	Social Inclusion		5	4	5	4
3	Sustainable	0,20	4,7	4,3	3,0	3,0
3.1	Sustainability Promotion		5	5	3	3
3.2	Sustainability Impact		4	4	2	3
3.3	Green Infrastructure		5	4	4	3
4	Innovative	0,15	4,5	5,0	2,0	3,0
4.1	Innovation Potential		4	5	2	3
4.2	Latest Technology		5	5	2	3
5	Valuable & Relevant	0,30	5,0	4,3	1,7	1,0
5.1	Research Contribution		5	3	1	1
5.2	Education Quality		5	5	2	1
5.2	Global Recognition		5	5	2	1
Weighted Product Model			3,9	3,4	2,7	2,4

Table 1. Scenario testing using WPM

For the numerical analysis of the alternatives, we used the weighted product model (or WPM) as this method is suitable in the cases where the criteria are not expressed in exactly the same unit (Triantaphyllou et al., 1998). After attaching numerical measures to the impacts of the alternatives on each sub-criteria, the WPM technique was used to determine a ranking. The ranking of the alternatives is as follows: A > B > C > D, being A the alternative with the biggest potential to fulfil the criteria.

To reach the proposed vision, both educational and cultural projects are required. In other words, we believe that an excellent educational hotspot without an attractive environment will be insufficient to maintain the skilled workforce needed to develop the desired expansion of the city, and vice versa. Therefore, rather than determining the best alternative, with this testing, we were interested in defining the relative importance of all the solutions under consideration, so that potential budgets and resources can be distributed proportionally.

Besides the criteria evaluation, a robustness analysis was carried out by assessing each solution against each of the external futures. This testing helped us to identify how well each solution would function in each future scenario (Zivkovic et al., 2016). As illustrated in Figure 9, solution A (Skellefteå University) seems to be the most appropriate alternative for all scenarios compared to the rest of the alternatives. It works completely well in the stable scenario, less in the innovative future since this University represents a more traditional rather than a very disruptive institution. It also works somewhat in the adaptive and collapsing scenarios as over the past centuries these institutions have remained despite dramatic events such as wars and pandemics.

In the case of solution B (Innovation Hub), it is a good fit for the scenario where innovation is encouraged, it also works well but to a lesser extent in the stable scenario where traditional industries are more dominant and is much less appropriate for the collapsing and adaptive scenario. Solution C (Recreational Center) makes a good fit only in the stable and innovative scenario since in both of the other futures, leisure activities will be the last priority in the city. Regarding solution D (Bonnstan 2.0), it can also make a good fit in the stable and innovative scenario, but it is somewhat less appropriate to the adaptive scenario in which changes are more abrupt, and to the collapsing scenario in which costs and impacts are so high than leisure and entertainment industries will be so much less prioritised. From this analysis, we can conclude that, in terms of education, solution A is more robust and in terms of culture, solution D is the one more suitable.

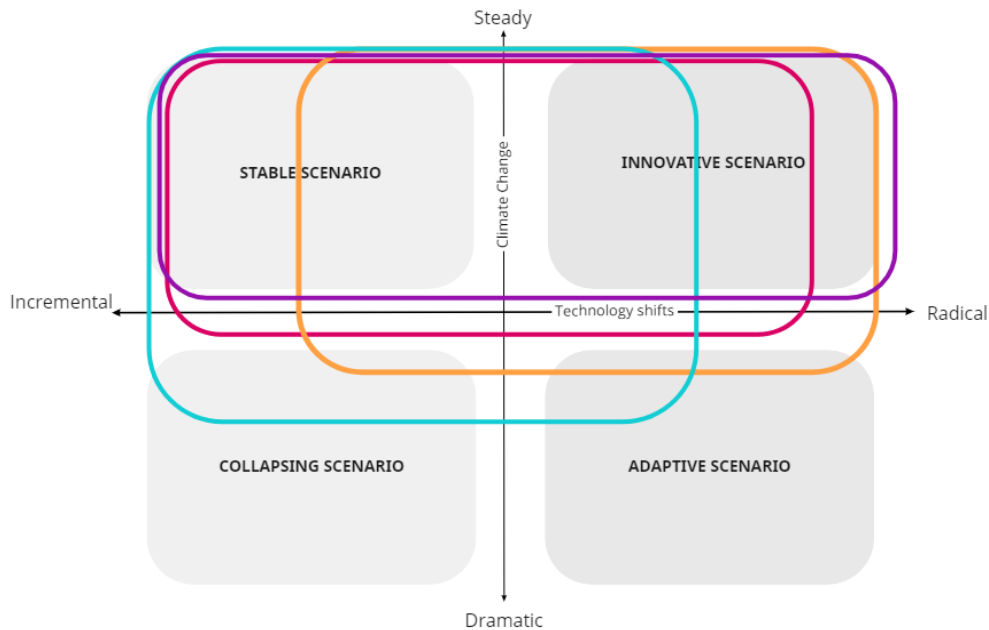


Figure 9. An overview of the robustness analysis.

3.11 Final Scenario

The need of developing the education and cultural sector simultaneously has been emphasised. Thus, the final combined scenario includes one solution for each front with linking factors in between. We chose alternatives A and D as the basis for the design of the final solution because they are the most robust in their respective categories, as shown in Figure 10.

Regarding education, it is indispensable for Skellefteå to have its own educational center so that the Municipality can be recognized worldwide as a cutting-edge education hotspot. Our proposal called *Innoversity*, encourages the adoption of a more radical approach by developing a non-traditional center focused on higher education, in which the following aspects comes into play:

First, the learning process must integrate the content, community, and practice elements (Modern learners 2022), and all of them must be shaped in a modern way to create a learning environment that can fulfil the needs of the future. In terms of content, sustainable development must be the core of all programs offered. Every course must be aimed at encouraging youth to create a sustainable future. Moreover, people must be able to meet, engage, create, and collaborate, that is, a community and a learning culture have to be created and sustained. Also, the interaction with the outside world is a crucial element to ensure a dynamic learning process. Collaborative projects with local industries must be ensured so that students can put in practice what they have learnt. Besides, by having contact with real-life issues, students will be inspired to learn more and to continually expand their creative capacity. This will also guarantee having an up-to-date education. Hence, the focus cannot be just on the content or just on one or two of the elements. An educational center of the future requires these components to become interdependent. Besides, the learning experience must be provided in both digital and physical spaces, so a 100% blended environment needs to be guaranteed.

Secondly, the learning experience can be modernised by applying the latest educational technology. For example, the content can be delivered through more innovative teaching methods such as animation and virtual reality. Collaborative learning can also be improved by the application of e-learning tools that enable students to interact with their peers and teachers easily. EdTech tools can also facilitate enabling students to learn at their own pace. Moreover, blockchain technology and artificial intelligence can bring benefits in terms of automatization and data storage, making transacting data more decentralised and transparent. It can also facilitate the verification of skills and knowledge of students during the job-seeking phase. Now, in terms of innovation, the strengths of solution B can be integrated. For instance, the university can provide innovation labs for students to meet, host events, collaborate and solve real-life problems in collaboration with local industries and businesses.

Third, this educational center must disrupt the traditional system by being more inclusive and less rigid. For example, the learning experience can be customised for each student, indeed, ideally it can be co-created with the learner. EdTech tools can also facilitate enabling students to learn at their own pace.

Concerning culture, we propose to establish *Bonnstan 2.0*, an area with a variety of cafés, restaurants, bars, and other entertainment venues aiming to combine the local culture with the global diversity. This place will keep the essence and style of the old Bonnstan, as a gathering spot and small-scale marketplace, but with a contemporary and creative ambiance to meet current people’s demands. It will contribute to providing a welcoming environment for new residents, but it will also aim at promoting social cohesion and inclusion. The establishment of both solutions must be done closely but in separate locations, so that Bonstann 2.0 can create a more vibrant environment not only for the students but for all residents of the Municipality, especially the young professionals willing to move in for work. Therefore, the educational center can be located within the current Campus, whereas the cultural district can be established in the surroundings of it.

Attracting more students through high quality, disruptive education, means more people with needs and resources, which will contribute to the dynamic growth of the cultural district. Besides, the educational center will also contribute by promoting social cohesion through the provision of gathering spaces and other social opportunities such as student clubs. Therefore, the development of the educational center will reinforce the growth of the cultural sector of the Municipality and vice versa as it is shown in Figure 10.

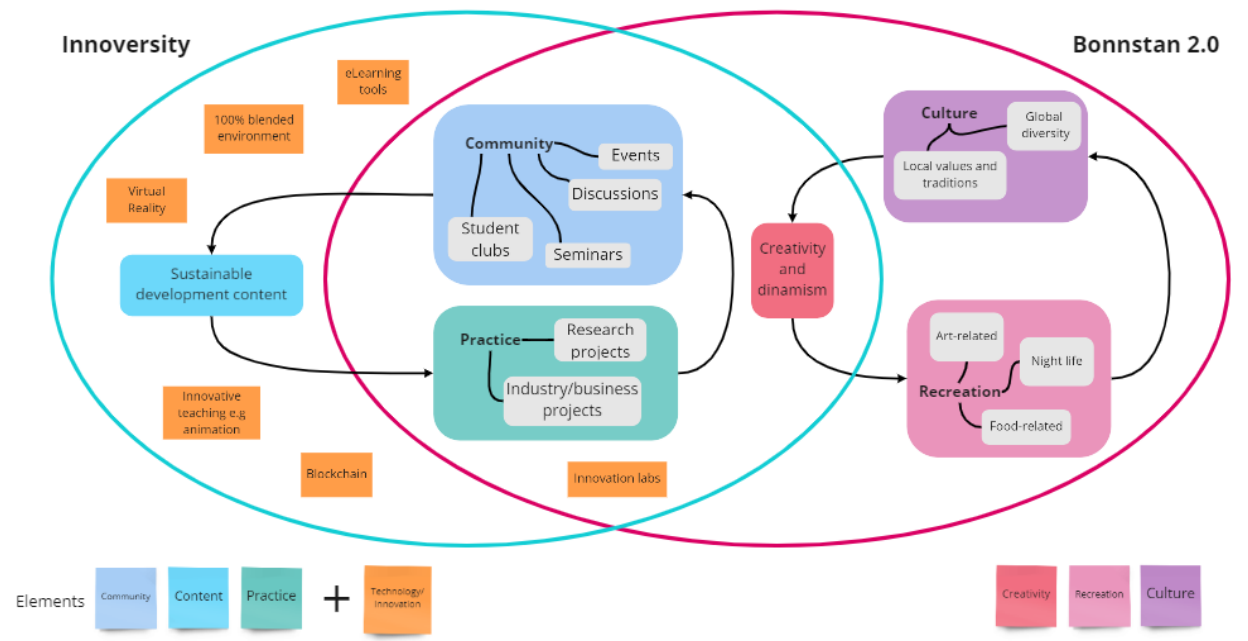


Figure 10. An overview of the final combined scenario

3.12 Pathway

The implementation of the proposed system requires cultural, structural, technological changes and the level of niche and regime related to the education and culture & leisure socio-technical system of Skellefteå. The changes required for the implementation of the Solution A and Solution D are divided into two stages based on the time-period. The first stage starts from 2022 and the second stage after 2030, as shown in Table 2:

Cultural changes	
1st Stage from 2022	<ul style="list-style-type: none"> • Strengthen collaboration with universities and expand campus activity • Organize global summer programs, to promote interest in Skellefteå and its opportunities • Development of the Bonnstan 2.0 area to give support culture & leisure activities
2nd Stage after 2030	<ul style="list-style-type: none"> • Broaden cooperation with researchers and partner universities • Identity transition to become a recognised hotspot for innovative learning • Promote innovative business, become a hub for innovation companies. • Increase indoor and outdoor activities, nightlife, cafes and restaurants.
Structural Changes	
1st Stage from 2022	<ul style="list-style-type: none"> • Create an international network of researchers. • Extended collaboration with other universities, companies and supporting start-ups created more opportunities. • Involvement of leisure & culture unions to promote history and leisure activities.
2nd Stage after 2030	<ul style="list-style-type: none"> • Establishment of Innoversity • Establish Bonnstan 2.0 to combine the local culture with the global diversity.
Technological Changes	
1st Stage from 2022	<ul style="list-style-type: none"> • Introducing EdTech courses related to big data, artificial intelligence, machine learning, blockchain technology, and sustainable development. • Blended learning environment: Innovation Labs to support the new innovations and research works.
2nd Stage after 2030	<ul style="list-style-type: none"> • Immersive learning with VR and AR • Collaboration with Arctic Energy Center for innovation and research.

Table 2. The proposed pathway for Innoversity surrounded by Bonnstan 2.0

The cultural changes required in the first stage are mainly on the expansion of the campus and science city. The expansion of the campus is all about collaboration with industries, transformation from the traditional system, blended environment, introduction of new programs, encouraging innovation and research. Initiative must be taken towards the sustainable transition and steps towards creating awareness and engaging citizens and municipality workers in sustainability. In the second stage, broad marketing globally - focus on target groups (e.g young adults looking for a peaceful lifestyle with an interest in sustainability), find top researchers to invite them to provide lecturers and encourage innovative business and aim to become innovation hubs.

The structural changes needed in the first stage are collaboration on campus with other universities, creating an international network of researchers so that top researchers can be invited to provide guest lectures, campus collaboration or collaboration of companies and supporting start-ups creating more opportunities. In the second stage of the establishment of Innoversity, a new place for higher education with lots of innovation labs, collaborative courses and Establish Bonnstan 2.0 to combine the local culture with the global diversity.

The technological changes are necessary for the final solution. The changes require steps to be taken such as improving the connection between the institutes and researchers, infrastructure development, investments, and implementation of pilot projects. The involvement of multiple stakeholders is needed in these changes such as municipality, research institutes, public and private companies, and the future students. The changes focus on a new learning system rather than a traditional system, introducing an eLearning platform, encouraging a blended education environment, encouraging new technology such as blockchain and big data analysis - as well as strengthening collaborations.

3.13 Experimentation

Experimentation is a central component in the field of sustainable transformation of socio-technical systems. It can be described as:

“An inclusive, practice-based and challenge-led initiative designed to promote system innovation through social learning under conditions of uncertainty and ambiguity” (Sengers, et al., 2019)

It takes place where society itself is the laboratory and all kinds of actors commit to an experimental process introducing alternative technologies and practices that can transform the social and physical reality. Experimentation can be a key agent of change, leading to fundamental shifts of societal functions. Cities are places where several socio-technical systems meet and interact, providing opportunities for radical changes when the right circumstances open windows of opportunity. However, the alignment of interconnected systems also contributes to increased complexity and path-dependency, which in turn can be a limiting factor to adopt radical changes. Therefore, it can be essential to define the role of city-officials and other major change agents in the transition management. Experimentation is often viewed as positive, yet sustainability-oriented experiments often tend to become isolated events with no effect on incumbent regimes. To avoid this, it is important to ensure supporting structures around the experiments (Sengers, et al., 2019).

For our suggested sets of experiments, we have identified that the key aspect to avoid these events from being only that, is to ensure ownership. Even before knowing if it is something that will be successful or not, it should be assured to have an assigned project owner and the possibility to make a budget for further development. Besides, we consider that regulations and frameworks are also key to support the upscaling process. Together with this, different types of technical and communication platforms are also crucial. To reinforce and highlight the outcomes of the experiments, it must be communicated to create interest, publicity and engage more people in the situation of upscaling. Before describing our suggested experiments are as follows: we would like to emphasise that there are already many great collaborations and initiatives taking place in Skellefteå, which could be integrated with our suggestions or extensions. It is great to take advantage of what already is happening, enhance and elaborate that by even tighter collaboration and emphasising on cross-sectorial engagements. The following experiments involving innovations of different nature are as follows:

Hackathon

The technological development is very rapid, in all sectors. To not fall behind this development, and to take advantage of new technology, it should be explored continuously. From a technical system development point of view, the trend is to develop more modular systems that can continuously be adapted and enhanced, instead of implementing a bigger change rarely. Technical knowledge and possibility to assess technical solutions are essential for all kinds of institutions, especially if consultants are hired for the technical development. The consultants have technical knowledge, but often little knowledge about the organisation and or local circumstances, and the other actor the reverse. In the terms of modern education, EdTech, VR, gamification, blockchain and other trending buzzwords, it is therefore central to establish basic knowledge and build stable partnerships and competence to find what paths are interesting for the future. A hackathon can be a starting point to learn more by people who are engaged in these technologies or are eager to learn more, to explore the future paths and trends for innovative education. For example, students (in Skellefteå and neighbouring cities) could be invited by the Campus and municipality to come up with ideas and share knowledge. To avoid this becoming a single event, it should be considered how and by whom this could be facilitated by in the future. Define a clear goal and purpose from the start, and in that way, it might be easier to attract relevant stakeholders for such an event. Suggested topics for investigation:

- Trends in EdTech: How to improve and innovate learning and the way content is understood?
- Blockchain: Could using blockchain technology be relevant in Skellefteå to create a decentralised educational center?
- Creative learning environments: How to combine physical and online teaching to accelerate learning, while also facilitating community and promoting good mental health for students?

Academia-Industry Workshop

Linked together with the more technical exploration of the Hackathon, it is suggested to organise a workshop between academia and industry. These types of collaborations are to our extent of knowledge already happening. However, what we would like to address here is the long term, to ensure the competence supply across all sectors. Also, to together challenge the traditional view of education and share ideas and insights on what type of competences and training that these companies see as useful for their employees. This type of exchange could enhance and deepen the understanding between employers and educational organs and enable co-creation of programs and courses. In terms of multi-level perspective (MLP) vocabulary, we think that the current changes in the landscape, such as high demand of workforce and rapid technological developments, could be excellent circumstances for niche breakthroughs. To address the need for a sustainable competence supply, traditional education systems could be challenged. Campus Skellefteå is already starting this, such as the usage of MOOC combined with study groups on campus, using available sources to speed up the availability and access high-class education with small investments. Organising a workshop focusing on adaptive and flexible competence development together with industry needs, could be a way to keep this already innovative approach to competence supply. Suggested themes to address:

- Competence supply: MOOC, courses, programs, vocational training, how to combine them to create attractive competence in Skellefteå, and to be globally competitive in certain fields?
- Challenging the traditional credential system: How to promote cutting-edge, adaptive and flexible education - that is still viewed as comparable with university credits? (Related to the point about blockchain in the Hackathon experiment)
- The future of research: What role does research play for the development of Campus and the industries?
- Which types of recruitments are often successful, and what skills do these persons have? Is a bachelor or master's degree essential, or are shorter courses and programs just as suitable? Are management, communication, or other skills more important?

Campus Design Competition

Physical expansion of campus and integrating with larger urban planning and social districts is necessary for thriving of young talent. Not only great job and study opportunities are enough for most young people these days, even for people who like a quiet and peaceful lifestyle close to nature. People moving in from abroad will require spaces and opportunities to meet, interact and have fun with others. Therefore, the design competition can be focused on enhancing and enlivening the campus by making a highly attractive environment (day and night, season to season) that promotes social cohesion and inspires community and visitors to explore new ways of thinking.

Cultural Business Workshops

To organise a series of workshops between social and cultural actors and invite a diverse group of people including young residents, business owners and employers, artists, and even potential residents, etc to find paths to develop the cultural district in the surroundings of the Campus. Important questions for planning the workshop are: What will participants do? Why is it important? What will the outcome be? What's next? Some of the objectives of the workshops could be:

- To synthesise existing knowledge regarding the current situation of the cultural sector.
- To generate a pool of ideas to achieve social cohesion between new and established residents in the area.
- To brainstorming for creating a sustainable and cultural environment with small-scale entertainment businesses.

Innovation Hub

This experiment is more a suggestion for an extension and growth of Science City. We think that a place (both physical and organisational) for co-creation of sustainable solutions can be crucial for exploring the future in the context of Skellefteå. Promoting and strengthening the collaborations between different industries, academia and also other national and global innovation hubs - to be inspired and build a broader competence network. Themes that could be explored:



Discussion & Conclusion

4. Discussion & Conclusion

This chapter will discuss and reflect on the modules of mPB, the overall work process, the limitations to the project and the conclusion.

4.1 General discussion and reflections of the work process

One of our initial reflections that has followed us throughout the entire project is how many great things are already taking place in Skellefteå. Whatever we have investigated, it has shown that something similar to our ideas is already ongoing or planned. This has certainly been challenging when trying to come up with new and creative ideas, but also very inspiring. The transformation of a place and a society is constant and iterative. In combination with different theories, studies, and our own work process, we have truly experienced the complexity of societal transitions through the case of Skellefteå. The iterative nature of the mPB played out well in this context, as for every step taken in the work process, we realised something earlier in our work had to be adjusted - which made us get deeper insights and a clearer understanding of our challenge. However, it was difficult to manage the iterative nature of the process when the course structure and seminars are following a linear structure. In some seminars we were not able to participate because we were somewhere else in our iteration process, which was hard since every module is dependent on the input from other modules. Instead, this made us follow the modules at our pace, and iterated when necessary, and took the time for the seminars to focus on understanding the task. However, this was not ideal and sometimes stressful to constantly have a sense of lagging behind.

The core of the mPB should be the participatory elements, which unfortunately were not sufficient in our project. As this is part of the essence of the method, it is certainly an element that we would have wanted to spend much more time with. To have gained more in-depth insights from various stakeholders would have been very valuable for the project and would be crucial to move forward. The lack of time, and constant iterations inhibited a more formal engagement with stakeholders. Since there were also some concerns about contacting certain companies or the municipality in Skellefteå, it made it even more complex. We would have hoped to have time for some interviews with Campus Skellefteå and some of the related projects going on there, such as the Arctic Center of Energy Technology, and some companies from industries other than Northvolt. Even though there were very limited opportunities for active involvement with stakeholders, the group itself has been active stakeholders in the position of potential future residents.

4.2 Reflection of the modules

Problem Orientation & Current Situation

Working on the problem orientation and current situation was probably the most time-consuming part in our project and was re-framed several times. Early on, the group agreed that our main interest was to focus on how to attract people with the wanted competence to move to Skellefteå. Firstly, we framed this as “lack of skilled workforce”, and later “shortage of skilled workforce”, but realising that was not exactly an ideal way to frame it. We did also re-frame and re-thought what societal functions to focus on, iterating this question several times. This was a long process that required many hours of group discussion, research about Skellefteå and attempts to understand the mPB method. When trying to define that problem and the current situation, we focused on both current residents and situations, and future residents. For example, we investigated local demographic patterns and generation shifts in the job market and what might be problematic or challenging for future residents to relocate and settle down, see more in Appendix. However, the lack of proper insight about the circumstances in Skellefteå continuously slowed us down from proceeding to adapt the modules. We found that it was crucial to be clear about the current situation, problem orientation and system boundaries for us to proceed in the thinking and working process – which in the end made us have less time for the following modules. It was difficult to integrate

all the insights and information that we could find by ourselves, to be sure if it was accurate, without closer stakeholder participation to confirm it. It was overwhelming to comprehend the load of information, which made us unsure about the accuracy of our interpretations and gave us a constant feeling of guessing and assuming – which felt uncomfortable. However, even though this part was time-consuming, we also found it made us more confident when finally, being able to continue our work process.

System Boundaries

Initially we were not sure about which societal function or sector to consider in relation to our problem. This eventually led to the re-framing of the problem and therefore also the system boundaries. As the defined challenge is addressing both factors regarding competence and attractiveness, we decided to include both the societal functions of education and culture & leisure. We aimed to incorporate a bigger perspective on ensuring the competence supply by also investigating what makes a place attractive to live in, and we concluded that social and cultural aspects are certainly important. Therefore, it felt necessary to include in the system boundaries. However, the effect of adopting a broader perspective is the sprawl, which has been challenging in later modules.

Stakeholder Analysis

In any complex socio-technical system, like Skellefteå, it is crucial to identify and address the role of stakeholders. In a complex system like Skellefteå, there are many stakeholders to consider and all of them are important to provide a holistic development of the municipality, but due to time constraints and limited resources to interact and identify relevant stakeholders, only a handful of them were considered. In addition, it was difficult to comprehend how specific or broad one should be while identifying stakeholders. Each stakeholder is part of a bigger group and each of them has various subgroups within them. For a more comprehensive project, a more detailed analysis of stakeholders should be done, where stakeholders at multiple levels are considered. For example, instead of having a stakeholder group of citizens, one can break it down into multiple subgroups like Sámi citizens, local Swedish citizens, Swedish citizens from other parts of Sweden, international people moving to Skellefteå, etc. Each stakeholder group has some common interests, but when one considers various levels of the same stakeholder subgroups their interests diverge from each other. Analysing the relationship between the stakeholder was also found to be important as it gave a perspective for lock in theory for various technologies and systems. The interdependency analysis of stakeholders gave validation to the possible solutions that can be implemented successfully without turning any actors into incumbent actors which can lead to dissolution of the proposed solution.

Needs and Functions

The needs and functions module were the turning point for completely re-iterating the entire project. When we started to work on it, we struggled on identifying the needs and functions due to the boundaries among these concepts were kind of vague and, because, at the beginning, we were trying to define needs and functions for the labour market, which by nature, is an abstract and complex element of society. However, after reframing the problem and started focusing on education and culture as societal functions with clearer limits, we managed to identify more easily what were the functions and then the related current needs.

Vision

As there is a lack of stakeholder engagement, we tried to include aspects that the municipality had already envisioned, to still include their perspective but with our own interpretation. The work process started with collecting key words that we found essential to emphasise related to our problem definition and system boundaries. The goal was to combine both the aspect of education and culture/leisure with the peaceful and simple lifestyle, closeness to nature – while also addressing the importance of Sámi rights and environmental sustainability. The insights gained from the data collection was mainly by getting inspiration in how to formulate a vision and how a vision could be a strong guiding force and an effective communication tool. The vision could certainly be elaborated and preferably be iterated together with other visions that are addressing other aspects and other societal functions. We think that it could be beneficial with greater divergence to highlight more aspects,

so that the convergence process leads to a specific and clear vision, but not excluding. For example, the vision that we formulated does not fully cover aspects of housing and mobility.

Criteria

To formulate the criteria, we focused on the vision, and how it could be divided into different goals. Starting with formulating sub-criteria (indicators), and how those could be measured. We defined a first version of sub-criteria and moved on to working on the following modules. During the following steps, the indicators were iterated several times, being refined to reflect the essence more clearly on what should be evaluated. After several iterations, we defined the main criteria, which were also changed a few times. If we would have had more time, a more substantial data collection of suitable indicators and how to measure them could have been done. We found it relatively hard to find both relevant data and to, by ourselves, formulate how to measure social aspects. More time, and several more iterations could have improved the accuracy of the criteria a sub-criterion in relation to our vision and final solution.

Driver Analysis

The Driver Analysis was an informative and useful module, where our own thoughts were combined with the work from the other groups during the seminar to identify and analyse the different drivers of the future. Creating the impact-uncertainty grid was a very useful task to connect thoughts that we had about the current situation, as we realised that they could be framed as trends, such as an ageing population. Although, it was sometimes hard to distinguish what is a trend or a key uncertainty, as we concluded that some could be both, such as climate change. At the beginning, it was a bit difficult to determine whether key uncertainties could be classified as external or internal factors. Due to this uncertainty, we initially chose to focus on internal factors to create the future scenarios, such as the carrying capacity of the municipality. However, after understanding that key uncertainties should be something that the municipality cannot affect, it was relatively easy to come up with the new future scenarios. All in all, it was a fun and interesting module to work with and it contributed to many good thoughts and ideas within the group.

Internal Scenarios/Solutions

In module Internal Scenarios/Solution was one of the challenging modules. The dimensions of the education function were easy to frame and the dimensions for culture & leisure was difficult to come up with. Framing the morphological table was difficult, especially when considering functions, working on this module made us think broader. The state of dimensions was given keeping in mind the future students and young professionals moving to Skellefteå. On analysing the morphological table, we found some interesting solutions. We created solutions for the societal function of the system. The challenge in this module is to satisfy the dimensions in the morphological table. We framed two solutions for education function and two solutions for culture & leisure. Even though this module was difficult, it was interesting working in dimensions and solutions for the functions.

Scenario Testing

The solution testing generated several iterations of the criteria. First, it was difficult to ensure a fair evaluation among all alternatives due to some being more related to education and other to culture. Therefore, to deal with this issue, we reframed the criteria in a broader way, so that the essence of each attribute could be applicable to all the alternatives. Afterwards, as the number of initial attributes was quite large, we decided to group them in major categories, to which we had to assign relative weights to carry out the quantitative evaluation. Therefore, one can say that the application of a numerical decision method was beneficial for providing structure to the assessment and was what led us to rethink how important each criterion was to reach the proposed vision. Regarding the robustness analysis, it helped us to realise our solutions might not be so resilient against all external scenarios. The biggest difficulties in this exercise were related to defining what would be the potential circumstances to the most unfeasible scenario. It would be beneficial to have more guides for establishing the boundaries of each future. This could facilitate the evaluation of the solutions against them.

Final Combined Scenario

The outcomes from the testing were useful to identify the direction to which our final solution should point out. However, it was very challenging to come up with a single solution that could integrate completely the two societal functions. Hence, we had to choose two alternatives out of the four initially proposed. These were the basis for our design, in which we tried to incorporate the most relevant attributes set in the criteria. Although there are two different solutions, they can be largely connected. In this way, our proposal serves to highlight the importance of the academia-industry interrelation to drive sustainability transitions. Nevertheless, it would have been interesting to have had the time and guidance necessary to define a more creative solution that could fully integrate education and culture.

Pathway

The module is worked in parallel with the combined final solution. The pathway is divided into two stages, one is from 2022 and another one is after 2030. The final solution is kept in mind and the milestones and targets to be achieved to achieve the final solution are created. The module change in the system is divided into three categories. Various stakeholders' participation is important in changes. The pathway on creating on assuming the rapid change in system and the sudden changes in migration population are considered. Some unplanned events can also take place in the system. The module was easy to understand and gave an action plan to be followed by Skellefteå towards Education and Culture & leisure.

Experimentation

Due to many iterations in our process, the time we had to elaborate this module was short. It could be enhanced with more data collection and investigation of different possibilities to carry out experimentations depending on the type of innovations addressed. The involvement of the municipality would have been also key to get some knowledge about what they have done and what has shown to be successful in previous years. We tried to elaborate on settings/experiments with multiple focus that the municipality could do to gather more input, learn about current trends within the topic, make different actors meet to brainstorm, and set a structure of ownership to certain initiatives. Lastly, we were not entirely sure about what the concept of supporting structure means and how to address it.

4.3 Limitations and recommendations for further exploration

One of the greatest obstacles regarding data collection has been that a lot of the more in-depth content about Skellefteå has been in Swedish. Some great insights were found in video recordings from the municipality, including interviews and in some presentation documents - information types that translation tools were not viable to use for. This was especially limiting for the non-Swedish speakers, as their prior knowledge about Skellefteå was even more scarce. It was also limiting the level of possibility to share information and have the same view, as these more interactive elements of information such as recorded interviews were closer to stakeholder engagement than more traditional data gathering. Throughout the entire project we experienced being limited by our lack of knowledge about Skellefteå, the people, the atmosphere, local culture, and characteristics. We find that it is not possible to gain the same kind of insights from just reading online, as from visiting the place, meeting people, and experiencing the atmosphere. With our limitations, we would sometimes feel concerned about being disrespectful by making assumptions and guessing, and even addressing something that does not even need to be prioritised. We argue that the future of a place cannot be outlined and designed by outsiders exclusively to be successful, therefore, we would suggest proceeding with further exploration in a collaboration of insiders and outsiders together. In this setting, the outsiders could act as facilitators, questioning and providing other perspectives.

Another limitation has been our own imagination. Thinking about visions, solutions and pathways for an actual existing place and context has to a greater extent been a limitation of creativity. This, in combination with the concerns of trying to solve an issue that is non-existent, made all of us more realistic. We struggled to come up with innovations that were radical, constantly realising that what we suggest is incremental development. Together

with the third greater limitation, time, it was even harder to find peace for enough creativity - while at the same time preserving a connection to the reality of Skellefteå. For further exploration we would suggest digging into more of the trends regarding the future of higher education, and how that could be explored and adopted by Skellefteå. However, it should be emphasised that systemic changes regarding for example the credential system of universities can be challenging to address on a city level, yet it could possibly be challenged on a local level. With closer collaboration and co-creation together with the municipality and Campus Skellefteå it would be interesting to explore the combination of the theory of leverage points with empowerment of stakeholders.

4.4 Conclusion

This study explored potential solutions developed in the mPB process for the sustainability transition of Skellefteå municipality by 2050. A future vision regarding the city's education and culture was established as well as the pathway to reach it. Additional suggestions were given for specific experiments to facilitate the work towards the future vision. Based on the mPB manual, a range of methods and tools and our own analysis, a final scenario that integrates two solutions was developed:

- *Innoversity*, a disruptive educational center that intends to utilise technological developments and innovation to optimise learning and promote cooperation between institutions, companies, and the municipality. It will serve the purpose of attracting the young competent people required for the development of the local industry and the city. Moreover, people from all around the world will attend Innoversity, hence creating diversity and a sense of camaraderie. It is therefore an important step towards reaching the vision and attaining social sustainability.
- *Bonnstan 2.0*, a cultural district in the surroundings of the Campus with modern restaurants, cafes, bars, and art-related venues. This place will integrate culture and entertainment in the urban planning to ensure that Skellefteå will be an attractive place for people of all backgrounds. This new version of Bonnstan will retain the essence of the old town to serve as a gathering spot that promotes social cohesion and inclusion. It will combine the local culture with the global diversity in a contemporary and creative ambiance.

5. Description of teamwork

The teamwork was organised through joint meetings and discussions, where Miro was used to a large extent as the main collaboration tool. Throughout the project, the modules of mPB have been worked with as a group, based on discussion and collaborative data collection. There were conflicting opinions on a few topics but with group discussions a consensus was reached in a respectful way. Individual reading and data collection was divided initially, with extended division of the workload in the final stages of the project. The individual work was most prominent in the writing process and preparation for the final presentation, but with established consensus on what to include. To enable communication and collaboration, a group chat and a shared google drive has been used, together with the group Miro board. A continuous dialogue was kept avoiding schedule clashes and to discuss and sort out any issues. As far as possible, physical meetings were used during the project work and the seminars. It was early agreed that this could be more engaging, as the perception and experience among the group was that online meetings can become boring and ineffective, especially regarding creative work.

Contributions

	Julia	Michelle	Olof	Priya	Rishabh
Executive Summary		X	X		
Introduction	X				X
<i>Aim & Objectives</i>		X			
<i>Methods</i>			X		
Results					
<i>1. Problem orientation</i>	X				
<i>2. System boundaries</i>				X	
<i>3. Current situation analysis</i>			X		
<i>4. Stakeholder analysis</i>					X
<i>5. Needs and system functions</i>		X			
<i>6. Future vision</i>	X				
<i>7. Criteria</i>	X				
<i>8. Driver analysis</i>			X		X
<i>9. Internal scenarios / solutions</i>				X	
<i>10. Scenario testing</i>		X			
<i>11. Final combined scenario</i>		X			
<i>12. Pathway</i>				X	
<i>13. Experimentation</i>	X	X			
Discussion					
<i>General discussion and reflections of the work process</i>	X				
<i>Reflection of the modules</i>	X	X	X	X	X
<i>Limitations and recommendations for further exploration</i>	X				
Conclusion		X			
Description of teamwork	X				
Final Presentation					X

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Appendix

Process documentation from Miro. For further exploration: <https://miro.com/app/board/uXjVOSx449E=/>

FIRST PHASE

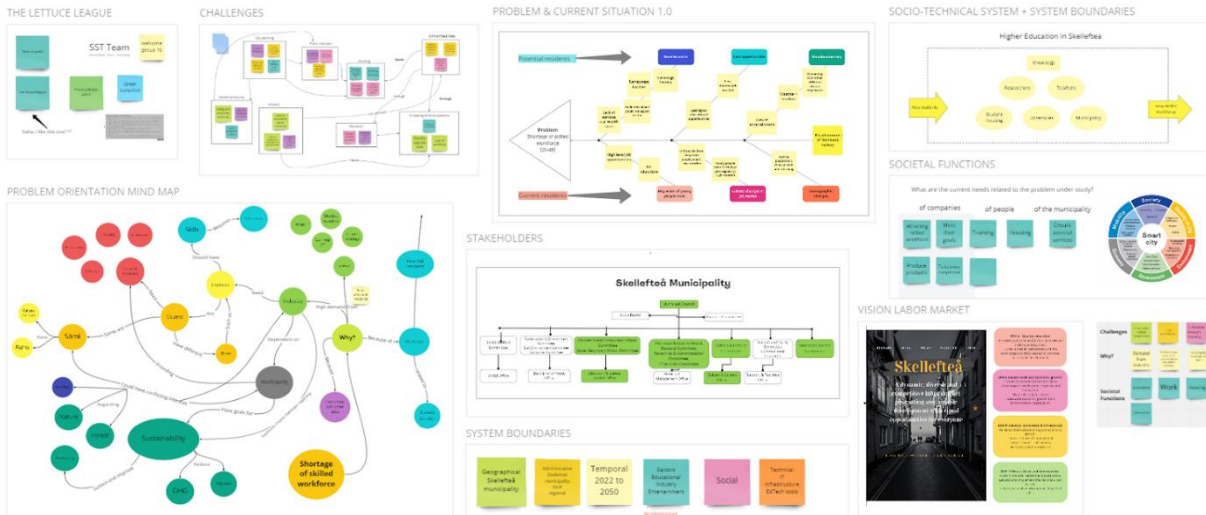


Figure 11. First phase of project with initial problem definition

STOP BEFORE MOVING FORWARD

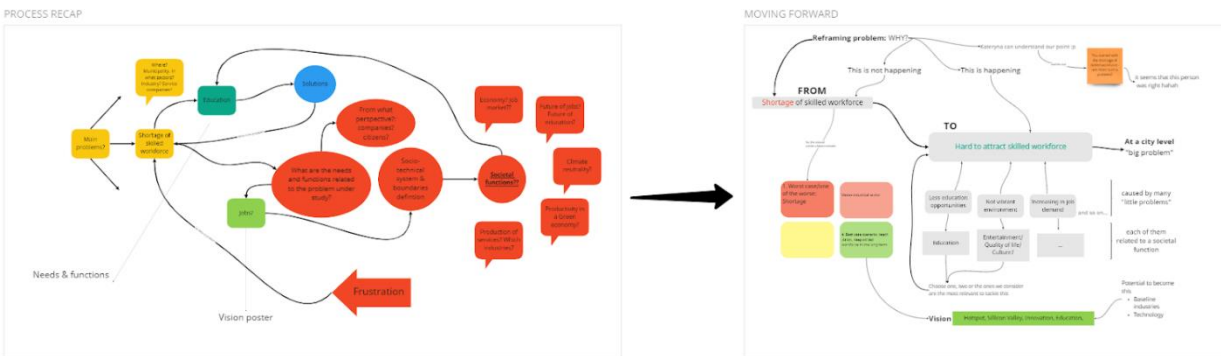


Figure 12. Reframing the problem definition

SECOND PHASE

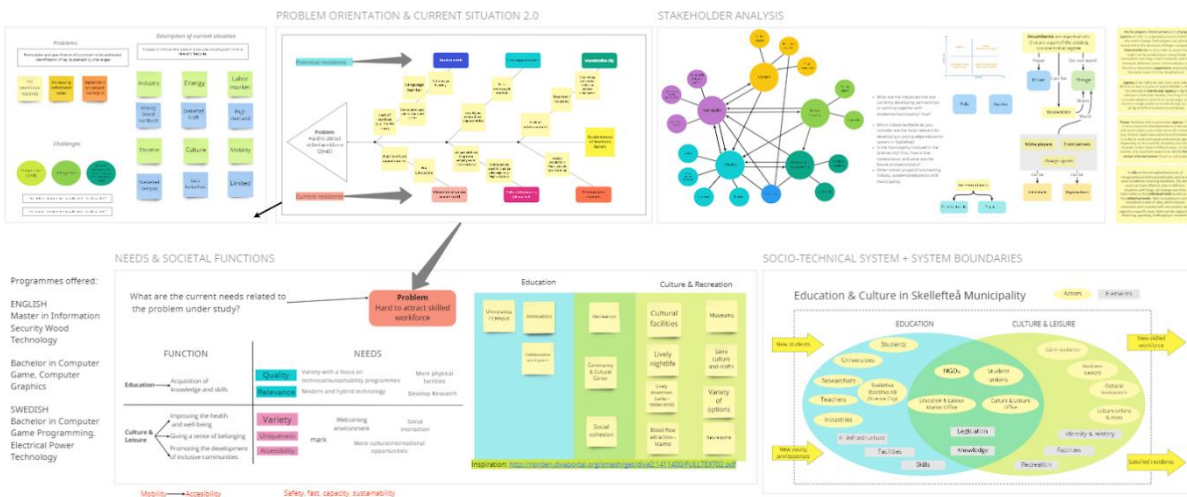


Figure 13. Second phase of project with revised problem definition

VISION

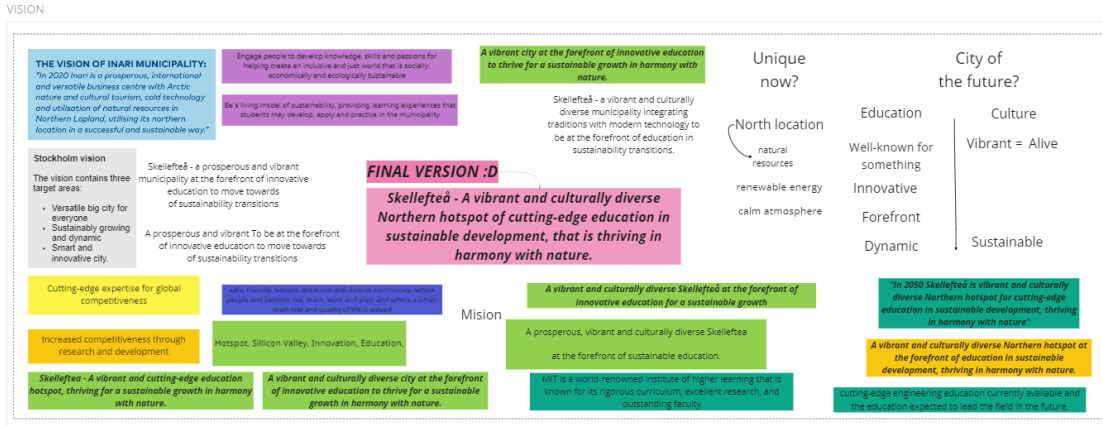


Figure 14. Defining the vision

THIRD PHASE

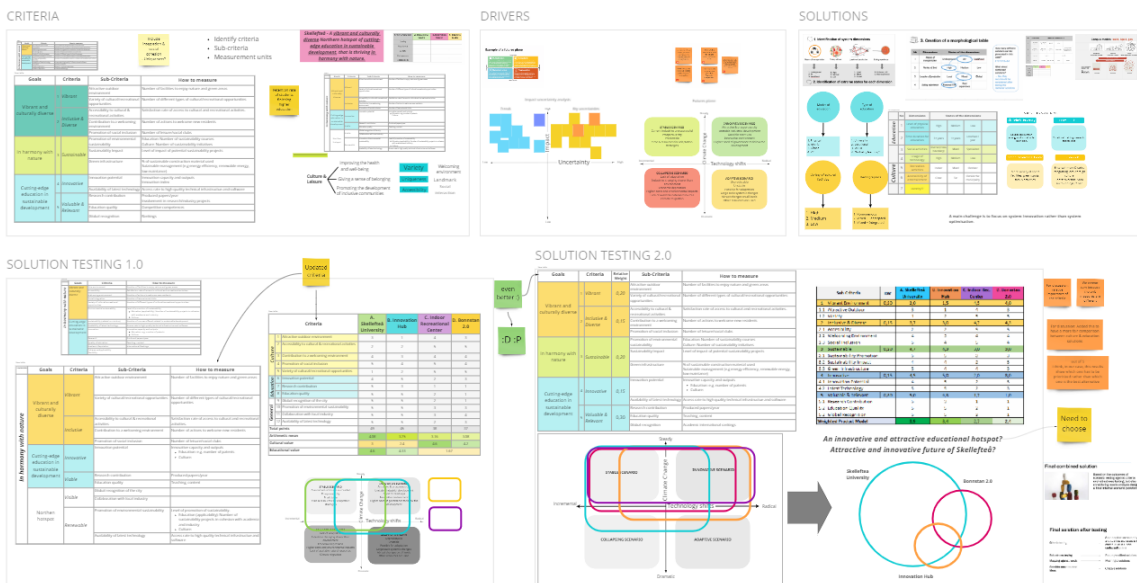


Figure 15. Finding solutions and testing them

FOURTH PHASE

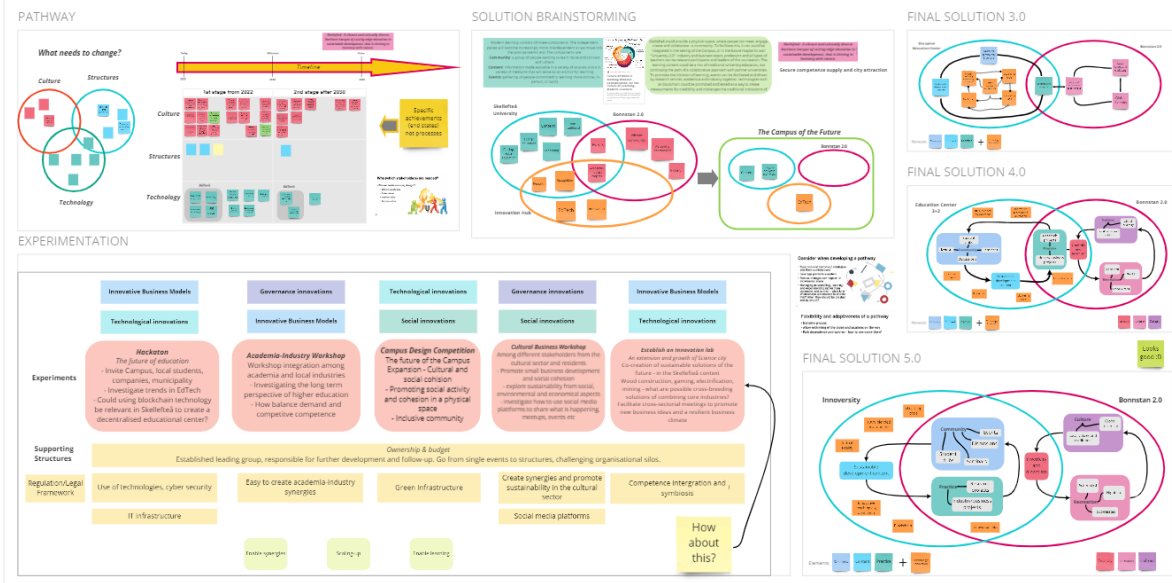


Figure 16. Final combined solution and experiment