Investigating Motivations of Sustainable Development Networks

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Abstract

Sustainable Development Networks (SDNs) are vital communities involved in sustainable projects in Copenhagen, yet many do not communicate effectively. Communication is hindered by many factors; however, the degree of impact from each is unclear. Growing Pathways, a Copenhagen-based organization, aims to facilitate connections in SDNs by providing tools, services, and research. This project investigates the existing SDNs to understand their current state, underlying motivations, and market demands to supplement Growing Pathways' tool-creation process and inform future steps

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Findings and Analysis	Garett and Nathan
Conclusions and Recommendations	Nathan and Brian
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Executive Summary

There are many supporters, stakeholders, and contributors working on sustainable projects, yet many individuals and groups do not communicate effectively. This communication is hindered by both a lack of motivation and an inability to connect; however, the degree of impact from each factor is unclear.

To understand sustainable projects, we must understand "sustainability", which is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). Sustainability is becoming increasingly important on the global stage and within Denmark.

In 2015 all 193 United Nations Member States adopted the 2030 Agenda for Sustainable Development, centered around the 17 Sustainable Development Goals (SDGs). These goals aim to develop a global partnership to improve the quality of life of all people, in the present and future (Transforming our World, 2015).

Copenhagen has implemented initiatives to cultivate a sustainable culture addressing green spaces, clean air and water, soil pollution, waste reduction, clean energy and transportation, and city revitalization. The city subscribes to the United Nations' Sustainable Development Goals, and has earned extensive awards for its ecological efforts, receiving the European Green Capital award in 2014 (Ministry of Foreign Affairs of Denmark, 2014).

As Denmark expands its portfolio of sustainable initiatives and projects, the network of people and organizations involved in sustainable development projects also expands and becomes more complex. This creates large and diverse Sustainable Development Networks (SDNs) and leads to communication challenges.

Ineffective communication causes a variety of problems for sustainable development. This includes creating knowledge gaps, limiting innovation, and dividing resources.

Growing Pathways, co-founded by Oleg Koefoed and Christa Amhøj, is a Copenhagen-based organization that works closely with Denmark's SDNs by "developing and maintaining urban resilience" through facilitating "positive loops of collaboration" in SDNs (Koefoed, 2019). They facilitate communications between their clients and projects in local government municipalities, businesses, and universities. Oleg Koefoed and Christa Amhøj created the Action University Conference to connect stakeholders across multiple urban sustainability projects in Denmark.

We can investigate SDNs using data analysis: the process of inspecting, cleansing, transforming, and modeling data with the goal of discovering useful information. Data analysis is broken into 4 main categories: Descriptive, Diagnostic, Predictive, and Prescriptive Analysis, describing the "who," "why," "when," and "how" of the network. Data analysis applied to networks is network analysis: visualizing and characterizing networks and their processes. This provides a descriptive model of the system through a display of the network, showing the "underlying processes

associated with the complex system of interest," which provides a diagnostic analysis of the network (Kolaczyk and Csárdi, 2014).

Market analysis can also be applied to networks. One marketing analysis tool is The House of Quality, a method of analyzing a target group to identify possible markets for new tools. This model reveals what tool attributes appeal to consumers and compares them to the options available to the provider (Hauser & Clausing, 2014).

Many different types of network analysis are required to understand SDNs, as a combination of models is required to create an accurate picture.

We used interviews and surveys to collect data.

First the team conducted one-on-one interviews to inform the context of the work from a personal, in-depth perspective. The interview questions covered three main topics:

(1) The individuals and their organizations.
(2) The collaborations and communications that they use.
(3) Their connection to the Action University.

The team needed to represent the concepts collected from interviews in a broader context beyond the track leaders so that our recommendations fit the perceptions of the entire community, rather than the specific niche of track leaders. To do this, the team conducted surveys using Qualtrics to create and send out electronic surveys to participants.

Network Analysis

To analyze the data collected from SDNs, we performed descriptive, diagnostic, and predictive analysis. We broke our goal down into 4 major objectives to analyze our data:

First, we determined how individuals perceive and describe communication and collaboration to accurately describe SDNs in Copenhagen. We investigated how to categorize actors, what community members focus on, and how actors communicate and collaborate.

Second, we aimed to understand the individuals' motivations to connect in the network to understand why the network formed as it did and how we can influence the network to change. This diagnostic analysis allows us to connect people in a network by aligning with the motivations that exist. Projects will fail if there is a mismatch between motivation and implementation.

Third, we wanted to understand existing collaboration tools and their benefits to identify and compare existing tools that enhance collaboration. This information told our group what tools already exists, allowing us to take inspiration from other sources.

Fourth, we identified areas of interest for tools, initiatives, or research that could enhance collaboration. To do this, we investigated three questions: How could a tool appeal to the market, what areas would benefit most from a tool, and what groups would be most receptive to a tool?

To predict the needs of the community we used a House of Quality model to define consumer attributes and evaluate existing tools.

Recommendations

Based on our findings and analysis, we recommend the following:

1. Our diagnostic analysis found that people in Copenhagen's SDNs follow mostly altruistic motivations. They prefer the innovation and inspiration that comes from collaboration over the financial benefits of participating. Future tools should appeal to this desire by focusing on the social aspects of collaboration.
2. The House of Quality revealed that social media platforms and educational classes synergize well with the market demands and motivations to collaborate within SDNs. Future tools should incorporate the social and connective aspects of these tools through new platforms or by extending these platforms to serve new purposes
3. The major obstacles to connection are a lack of time and resources. This is because successful collaboration requires active participation from all involved parties, increasing the commitment required to collaborate. Future tools must not increase the time required to form new connections. The user interface must be simple and intuitive, so that users do not need to commit more time to learning the software.
4. Our conclusions can be used to brainstorm new tool ideas based on the needs of the community. We generated several recommendations of tools based on the previous conclusions, as shown in Table 3 of the Conclusions section.

1 Introduction

If we do not prioritize sustainability in our future development, we will cause irreparable damage to the planet by 2030 (United Nations, 2019). If our world does not shift to a more sustainable trajectory, then climate change, pollution, and waste will consume our world. Effective sustainability requires worldwide collaboration and communication.

Sustainability is an umbrella term that covers many goals, disciplines, cultures, and individuals. Sustainability means meeting current needs without compromising the ability of future generations to meet their own needs. This means that sustainable development must accomplish its goals while being conscious of its consequences on people, economies, and environments. The main challenge sustainable development projects face is the lack of communication between different people and organizations contributing to them.

The world is shifting its focus towards sustainability. The United Nations recognizes its importance through their 17 Sustainable Development Goals for 2030. Each member country creates its own plans based on this framework. Denmark is a leader in sustainable development and Copenhagen, the capital, has taken concrete steps to improve their green space, reduce energy consumption, and prevent pollution. The city even plans to become carbon neutral by 2025 (Birnbaum, 2019).

Copenhagen has implemented initiatives to cultivate a sustainable culture addressing green spaces, clean air and water, soil pollution, waste reduction, clean energy and transportation, and city revitalization. The city subscribes to the United Nations' Sustainable Development Goals, and has earned extensive awards for its ecological efforts, receiving the European Green Capital award in 2014 (Ministry of Foreign Affairs of Denmark, 2014).

Sustainable development initiatives involve many stakeholders from a spectrum of locations, expertise, and perspectives. This complexity makes effective communication among stakeholders difficult. Prior literature indicates that the overall functionality and success of sustainable development projects relies on a shared understanding between all stakeholders. When these stakeholders fail to agree, synergies may be missed, and conflicts may arise.

Growing Pathways, a Copenhagen-based organization, is working to address this communication challenge. They focus on "building the capacities needed for a society that grows beyond sustainability" (Koefoed,2020). Working as researchers, consultants, and communicators, Growing Pathways reaches a wide range of clients, nationally and internationally, who want to align their mission with sustainable development goals. One of Growing Pathway's projects is the Action University, a community outreach cooperative designed to facilitate new connections between participants. The Action University will host a series of conferences beginning in 2021 to bring together actors, meaning individuals or organizations, in the sustainable development network of Copenhagen and beyond (Koefoed, 2020).

The Action University is the driving inspiration for this project. Due to the COVID-19 virus, the in-person conference was delayed, leaving an opportunity to cultivate communication virtually. Growing Pathways sponsored this research to investigate how a new online tool could promote collaboration and community building within these sustainable development networks. The project investigates motivations and interests in the network and existing tools used by the individuals in the network through descriptive, diagnostic, and predictive models. We used data gathered through interviews and surveys, and we uncovered common motivations, popular tools, and community desires. We then recommended options for Growing Pathways to move forward with this process.

2 Background

This chapter first defines sustainability and its global impacts, the importance of sustainability initiatives within Denmark, and how Sustainable Development Networks (SDNs) play a major role in their completion. Next, we explore the major roadblocks to successful collaboration within these networks and the obstacles faced by prior attempts to facilitate this communication. Finally, we examine how data from social networks can be analyzed to provide a deeper understanding of communication and motivations within these networks.

2.1 Sustainability

Sustainability is a concept of increasing global importance in the recent decades. The most widely used definition of sustainability is from the UN's 1987 Brundtland Commission Report, which defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"(Brundtland, 1987). With the increasing threat posed by climate change, sustainability has been the target of recent efforts by the United Nations.

2.1.1 Global Sustainability

In 2015 all 193 United Nations Member States adopted the 2030 Agenda for Sustainable Development. The core of this agenda is the 17 Sustainable Development Goals (SDGs), which outline how countries should aim to develop to achieve sustainability ("About the Sustainable Development Goals", n.d.). These goals aim to develop a global partnership to improve the quality of life of all people, in the present and future ("Transforming our World," 2015). The SDGs cover a wide variety of topics and industries, addressing human living and working conditions, government policy and structure, wildlife, and resource usage. This requires a wide array of expertise, meaning many sustainability efforts are transdisciplinary in nature (Huutoniemi, 2014).

Many other countries have started to experiment with sustainable development and the SDGs. Using the SDGs as guidelines, South Africa developed their own set of goals focusing on "multi-dimensional framework for addressing the principal challenges of poverty and inequality in South Africa" (Cumming, 2017). To achieve these goals, they have focused on improving ecological infrastructure, increasing the availability of water, improving shelter's resilience to natural disasters, increasing conservation efforts for marine and terrestrial life, and creating jobs to achieve these efforts. One of these projects is the Debt-for-nature swaps, which is an agreement to cancel debt in exchange for reinvesting it into sustainable development. The Government of Seychelles has seen success using US$ 29.6 million of this freed debt capital to finance the creation of "marine protected areas the size of Germany" (Cumming, 2017).

In contrast, some countries lack proper planning to achieve sustainable results. Bangladesh has experienced issues when attempting to improve Urban Sustainability. They adopted practices from British urban planners and attempted to use them in the development of Khulna city (Rahman, 2016). However, these plans fell apart with the conjunction of "rapid urbanization

process and resource constraints in developing countries" (Rahman, 2016). The plan was focused on land use to solve larger sustainability issues without considering local resource constraints (Rahman, 2016).

2.1.2 Sustainability in Denmark

Denmark has an exemplary outlook on sustainability. As a coastal nation Denmark is vulnerable to the impacts of climate change, such as rising sea levels and stronger storms. It also has a history of creating policies that look out for every member of their society. Consequently, Denmark has embraced the Sustainable Development Goals (SDGs) set out by the United Nations in 2015. Denmark's United Nations page details its commitment to the SDGs, as a part of "a long-standing Danish tradition of pursuing solutions that are sustainable in the long run". The web page notes that Denmark's government emphasizes the need for "all actors across society to contribute to achieving the SDGs', encouraging a large and diverse population to work towards these goals ("Denmark Sustainable Development Knowledge Platform," 2017). As a world leader in sustainability and future-oriented development, Denmark focuses on innovations that solve environmental, economic, and social sustainability issues.

2.1.3 Sustainable Development Networks

The analysis of social networks is a powerful tool to provide insight into the communications within communities (Otte & Rousseau, 2002). One type of these social networks is Sustainable Development Networks (SDN).[1] These social networks — networks of individuals connected through interpersonal relationships — are an integral component of sustainable development projects. They represent the connections between the diverse stakeholders, target groups, and resources in a web of actors.

The transdisciplinary nature of sustainable development projects requires many people with different backgrounds to cooperate successfully. Working on sustainable projects "builds a large number of bridging ties leading to external resources" (Newman & Dale, 2006). A Sustainable Development Network is a way of conceptualizing the individuals/organizations, the projects they work on, stakeholders in those projects, and the communication between all groups. For example, a construction company working on a city park connects to the environmental consulting company to avoid damaging the local environment. They would also connect with the waste management company handling the debris they create in sustainable ways. Once the park is complete, they are then connected to the citizens using the park. This hypothetical SDN is illustrated in Figure 1.

[1] An SDN should not be confused with the Sustainable Development Solutions Network (SDSN), an official organization with a concrete set of defined members and functions. An SDN is a loose definition describing unofficial networks focusing on sustainable development.

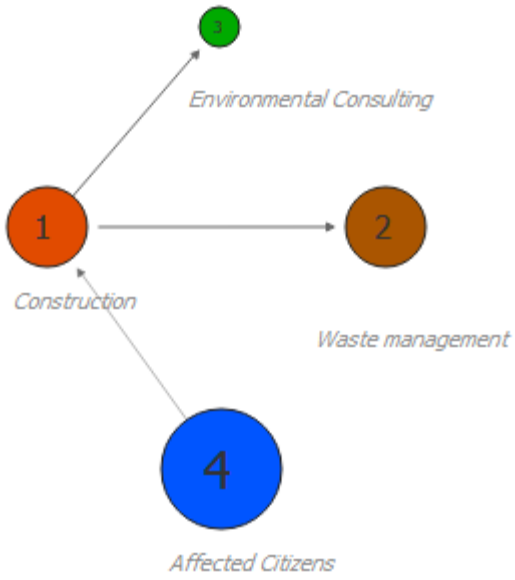

Figure 1: Sample Network Map

2.1.4 Denmark's Growing Sustainable Development Networks

As Denmark expands its portfolio of sustainable initiatives and projects, the network of people and organizations involved in sustainable development projects also expands and becomes more complex. This creates large and diverse SDNs and leads to communication challenges.

The large, diverse nature of these networks hinders communication because of the transdisciplinary nature of actors (Huutoniemi, 2014). Differences in vocabulary, background understanding, and communication methods lead to semantic challenges when attempting to communicate about their work. The size of these networks may also lead to missed connections, or failure to account for an unknown stakeholder in a project, such as impacted citizens. Some of the challenges and problems that arise from flawed communication within SDNs appear in section 2.2. Actors must address these problems for these networks to function well and for the sustainable development projects to be fruitful

2.1.5 Growing Pathways Encourages Communication within SDNs

Growing Pathways, co-founded by Oleg Koefoed and Christa Amhøj, is a Copenhagen-based organization that works closely with Denmark's SDNs, as explained in Appendix C. They support the SDGs in Denmark by "developing and maintaining urban resilience" through facilitating "positive loops of collaboration" in SDNs (Koefoed, 2019). They facilitate communications between their clients and projects in local government municipalities, businesses, and universities. The organization creates "environments based on collaboration, openness, and the shared understanding of a goal" between a broad set of clients (Koefoed, 2019).

Oleg Koefoed and Christa Amhøj created the Action University Conference to connect stakeholders across multiple urban sustainability projects in Denmark. They invited central

players in sustainable development who are looking to expand their network. The 2020 conference was delayed due to the COVID-19 pandemic, but the conference track leaders are a valuable resource used within this study. A series of four conferences will be convened by the Action University between 2021 and 2023.

A key tool that Oleg is using in his conferences is the 6 P's. The 6 P's are an extension of the United Nation's 5 P's which are a way to measure progress towards completing the core 17 SDGs (Brown, 2019). The 6 P's stand for People, Planet, Prosperity, Peace, Participation, and the one Oleg added, Place. Oleg uses these ideas as a tool to judge how projects affect people and the community around them.

2.2 Problems Arising from Ineffective Communication in SDNs

Ineffective communication causes a variety of problems for sustainable development. This section details several of these problems to showcase the necessity of strong communication in SDNs.

2.2.1 False Assumptions Between Groups

Ineffective communications between groups leaves a gap in knowledge about their beliefs, values, and motivations, leading groups to create false assumptions to fill in this gap. Oleg Koefoed shared an example of a project run by the city of Copenhagen, called "My Secret Place," designed to provide a platform for citizens to share their favorite, little-known places in the city. However, a lack of communication between the target group and researchers failed to identify a major assumption: Citizens did not want to share their "secret places". The citizens would prefer to keep their places secret and personal, rather than sharing them with the whole city.

As Oleg describes, the project lacked a dialogue between the researcher and citizens that would have avoided the wasted effort caused by unexamined assumptions. He notes that people must "know the motivations and barriers beforehand" for a project to be successful.

2.2.2 Limited Opportunities within SDNs

On his collaboration with Robert Hooke, Isaac Newton stated "If I have seen further it is by standing on the shoulders of Giants." Through this, Newton conveys that his discoveries were only possible due to the collaboration and communication with fellow researchers. Similarly, sustainable development projects can share solutions and methods to enhance their work. Without this communication, SDNs often "reinvent the wheel" due to lack of information about other groups' efforts. In their research, Newman and Dale (2006) found that forming connections between networks grants access to "resources and opportunities that exist in one network to a member of another". Without this access, groups in sustainable development must repeat work, forcing parties to invest sizable resources re-develop an existing solution, increasing costs and frustrating sustainable progress (Newman & Dale, 2006).

Isolated groups and individuals also lose unique opportunities that arise from collaboration. Oleg Koefoed recounts how most people do not "look across the street" to connect with nearby groups

to form beneficial connections. Oleg shared the story of a successful connection between a robotics program and a local community garden, incorporating robotics into the gardens. Through the collaboration, the robotics program developed innovative technology to assist the garden, while the garden attracted more visitors and customers.

2.2.3 Division of Resources due to Competing Goals

A major issue affecting large networks is the division of resources. As the networks grow, communities find their resources "stretched over a myriad of issues, many of which are complex and overlapping" (Newman & Dale, 2006). A division of resources, caused by ineffective communication, will hinder sustainable projects

A previous Interactive Qualifying Project (IQP) study done in Costa Rica: "Foundation Image - Communication Bridges for Environmental Organizations" examined this effect. The project investigated the lack of communication between environmental groups in a small professional network with limited resources. Organizations with similar goals competed for a small pool of funds. This split resources, limited the implementation of objectives, and forced efforts to be unnecessarily repeated. Infrequent connections with similar groups wasted funding, reduced motivation, and ultimately, hindered progress towards fixing environmental issues (Dennen et al. 2000).

2.2.4 Short Term Focus

The United Nations warns that we will cause irreparable damage to the planet by 2030 if we do not lower our emission production. To tackle this issue, we must focus on large, long-term sustainable projects to reduce emission before it is too late. One example of this is Copenhagen's district cooling system that took 10 years to construct from its inception in 2010. This project replaces traditional cooling systems in the city in favor of centralized tools that use seawater to reduce emissions by 30,000 tons each year ("District Cooling," 2019).

Despite the benefits of large-scale projects, many projects in Denmark are directed at short term goals, only affecting the country for a few years after the project's start date. The University of Copenhagen's Urban Studies department investigated the city's climate adaptation strategies through a qualitative and quantitative survey for citizens and workers. The results revealed a flaw in Copenhagen's developments: without establishing long term connections between actors, progressive and sustainable projects focus on individual short-term goals (Hedensted, 2012).

This focus on the short-term problems is a mismatch between Denmark's goals and their execution. Gulsrud found that the extended timeframe of large sustainable projects did not correspond to market demand, municipal budget forecasting, or the 4-year election cycle of city politicians. (Gulsrud, 2013). This identifies a critical failure in how we address sustainable projects: if governments, citizens, and businesses operate on a timescale of months to years, how do we develop projects that can take decades? With all these networks focusing on their individual goals, the objectives of our society cannot be achieved. Thus, it is vital that we shift our efforts to support these projects through the establishment of long-lasting connections

between actors who can coordinate and sustain this effort where traditional channels of communication and facilitation are ineffective. With strong, effective communication, projects can ascend beyond the scope of individual efforts to combine the resources and goals of systems and networks.

2.3 Obstacles to Facilitating Communication in SDNs

Past attempts to overcome these communication problems in SDNs have run into obstacles. We investigated the direction that these previous attempts have taken and the challenges they faced to identify roadblocks.

Large sustainable development networks need tools and methods to facilitate connections between the participating actors for sufficient communication within the network. In their work, Katri Huutonie found that communication in SDNs “builds the common ground and mutual understanding necessary to support effective responses to [large network] problems." Katri continues to show that approaches to improve communication range from tools (e.g. concept mapping), addressing specific challenges, to broader approaches (e.g. deliberative strategies) to facilitate communication at all stages of the project (Huutoniemi 2014).

Previous IQPs sponsored by Growing pathways have attempted to develop tools to facilitate communication within isolated communities. Johanna Whitwell, from one previous IQP, explained that her group initiated a project to facilitate communication within the limited scope of urban farmers. They conducted interviews with urban farmers to attempt to uncover a demand for a tool that would facilitate communication. During this process, however, they found that these small groups were not motivated to reach out to others (Whitwell, J. 24 May 2020). This lack of motivation left the project team with no paths to explore. Because the team did not understand the motivations and demands for tools within the network, they could not develop a useful one. This reveals the importance of understanding the underlying characteristics and motivations of these groups in depth.

2.4 Methods of Data Analysis for SDNs

We can investigate SDNs using data analysis: the process of inspecting, cleansing, transforming, and modeling data with the goal of discovering useful information. This process is an important step to understand any data set. Our data analysis was broken into 4 main categories: Descriptive Analysis, Diagnostic Analysis, Predictive Analysis, Prescriptive Analysis. Descriptive analysis answers the question “what is happening?” by identifying the current state of the network. Diagnostic analysis answers “why is it happening?” describing the underlying causes and motivations forming the network. Predictive analysis reveals “what will happen?” by finding trends that impact future events. Finally, prescriptive analysis identifies “how to get a desired outcome” to investigate how a tool can influence connections in a network (Gibson, n.d.).

Kolaczyk and Csárdi, in Statistical Analysis of Network Data with R, describe a set of techniques to analyze networks. They break network analysis into models of visualizing and characterizing

networks, network modeling and inference, and network processes. Each of these is important to understand a network. Visualization and characterization are “usually the first steps in network analysis." They provide a descriptive model of the system through a display of the network and its nodes. Network modeling describes “underlying processes associated with the complex system of interest,” which provides a diagnostic analysis of the network (Kolaczyk & Csárdi, 2014).

These data analysis types and techniques are directly applicable to SDNs. To understand complex networks, a combination of models is required to create an accurate picture.

3 Methodology

In this chapter we discuss our problem statement, the goals we developed to address it, and the objectives we followed to reach the goals. We then discuss our primary sources of data collection and the types of analysis done on the data set.

We developed our project goal to address problems caused by ineffective communication within SDNs. We seek to understand the background of communication and collaboration in Denmark's sustainable development networks, what motivates it, and how to improve it. Table 1 contains our goal we set to solve this problem, and the objectives required to achieve it.

Table 1: Goal and Objectives

Problem Statement:	
There are many supporters, stakeholders, and contributors working in SDNs, yet many individuals and groups do not communicate effectively. This communication is hindered by both a lack of motivation and an inability to connect; however, the degree of impact from each factor is unclear.	
Goal:	**Objectives:**
Understand the background of communication and collaboration in Denmark's sustainable development networks, what motivates it, and how to improve it	1. Determine how individuals perceive and describe communication and collaboration 2. Gain an understanding of what motivates individuals in the network to connect 3. Understand the existing sustainable development networks' communication and collaboration tools and their benefits. 4. Identify opportunities for promoting collaboration between actors

3.1 Data Collection

Our team gathered information from various sources for this project to analyze and address our goals and objectives. These techniques were applied throughout our objectives.

3.1.1 Interviews

The team conducted one-on-one interviews to inform this context of the work from a personal, in-depth perspective. We connected with participants through the Action University's co-founder and co-coordinator Oleg Koefoed. We were given the contacts of the Action University track leaders; these are the individuals leading the 20 program tracks, covering their work in sustainability and leadership. These Action University track leaders have hands-on experience within Copenhagen's SDNs. The interview questions covered three main topics: (1) understanding the individual and their organization, (2) examining the collaborations and

communications that they use, (3) revealing their connection to the Action University and the 6 Ps. These interview questions can be found in Appendix A.

The team decided to use coding to organize and analyze the interview results. Coding is the process of assigning short, descriptive words, called code keys, to describe major areas and focuses within a set of qualitative data (Wicks, 2017). We used a table to organize these codes, where each interview is a column, and each row is a code relevant to our objectives. This structure will generalize the specific responses into identifiable groups. The code keys are created by analyzing the sentiments of statements and grouping them together in an iterative process. After each interview, the team met to create, group, and cut keys until a final list was reached. We then found trends within these code keys, as shown in Appendix E.

The major limitation of the interview data is the breadth of its participants. Because we only contacted individuals within one specific network, all acting as track leaders at the Action University Conference, our results may be biased towards consultants. One way to compensate for this bias is to ask them about how their perspective match the broader population, as these types of actors have many interactions with other groups. This method allows participants to abstract their specific answers to be more representative, but it is still limited by their experience with other actors in SDNs.

3.1.2 Surveys

We needed to represent the concepts collected from interviews in a broader context beyond the track leaders so that our recommendations fit the perceptions of the entire community, rather than a specific niche. To do this, the team decided to conduct surveys using Qualtrics to create and send out electronic surveys to participants. See Appendix B for the questions.

To ensure the sample represented the population, a large sample size was required. To gain participants for this survey, we used a “Snowball” sampling method. Snowball sampling is a method of selecting new candidates from the responses of previous participants. Surveys were sent out to central stakeholders after the initial interviews with them. These surveys included sections asking the actors to identify any partners they collaborated with or to send the email to colleagues. Each identified partner would then be recursively surveyed and asked to identify additional connections (Vance-Borland & Holley, 2011). This process continues until a sufficient number of surveys are received (or completed) or until we cannot identify new stakeholders. The goal was to collect 100 survey responses. Our goal was to collect information on how individuals and organizations communicate and work, so the content of the surveys depended upon the interview results.

Snowball sampling has significant shortcomings. Since new participants come from previous responses, a bias could isolate external SDNs that do not overlap with the initial population. The technique also risks a lack of participation: If individuals do not identify other candidates, then the sample size may be too small. To account for this, the team sent the initial survey to multiple

groups outside the Action University by using existing groups of actors, such as State of Green ("About State of Green", n.d.).

3.2 Objectives

To achieve our objectives, we used different kinds of analysis on our survey results. Each analysis method reveals a different dimension of the SDN, and they are detailed in Table 2.

Table 2: Analysis Types and Models

Analysis type	***Model***	***Benefit***
Descriptive	Social Network Map	Reveals what the network "looks like." This form of model highlights patterns within the community based on their location within the network.
Diagnostic	Group Distributions	Shows how common certain groups are in the community. This analysis highlights the prominent groups and their motivations.
Predictive	House of Quality	Identifies consumer demand within existing tools. Highlights areas where existing tools are lacking.

3.2.1 Perceptions of SDNs

Objective: Determine how individuals perceive and describe communication and collaboration.

The purpose of this objective is to accurately describe SDNs in Copenhagen. We investigated how to categorize actors, what community members focus on, and how actors communicate and collaborate.

To understand and describe an SDN, we planned to use a social network map as a form of descriptive data analysis. We will benefit from the map by analyzing the social network to identify key actors, strong and weak connections, and visual subgroups. This process reveals "relationships between data elements" and defines "leadership needs" (McLinden, 2013).

A social network map is a visual tool that displays social connections and values within a community by drawing a web of the people and the links between them. The method graphically represents the connections by drawing actors as nodes or vertices and communication as lines connecting them, and it is a common first step in the descriptive analysis of a network (Kolaczyk & Csárdi, 2014)

Analyzing social network maps provides several metrics that describe actors in a network: centrality, proximity, and betweenness. Centrality is a measure of how central one individual is within a network. A user with more, stronger connections has a higher centrality. This reveals key players in the community. Proximity describes how closely two individuals are connected, identifying groups that are closely linked. Betweenness describes how an individual acts as an

intermediary between other connections. This identifies gatekeepers: single individuals that facilitate communication between larger groups. To calculate these values, we used software described in Appendix D.

Using our code keys, we developed a list of categories to classify actors in sustainable development. We then applied these categories to design our survey questions to analyze survey responses.

Finally, we planned to use our surveys to populate the data set for the map. The key metrics would have been calculated from this pool of data, and the maps would be created. Connections were made by asking users to send the survey to colleagues and asking for the name of who had referred them to the survey. Data representing these connections (adjacency matrices) would have been entered into SocNetVis for analysis. See Appendix D for details on social network visualization software. Unfortunately, our data did not yield enough information to construct a social network map, as discussed in our Findings section.

3.2.2 Understanding Motivations

Objective: Understand the motivations that connect individuals in the network

The purpose of this objective is to understand the complex set of motivations and influences acting on the network. Attempts to connect people in a network must align with prominent motivations that exist in the network. Projects will fail if there is a mismatch between motivation and implementation.

We investigated the driving motivations of actors within SDNs by collecting data directly from Action University track leaders. A set of interview questions is focused on track leader's motivations to connect and collaborate. As hosts of the Action University conference, they have a unique motivation to network and communicate. We included questions in the interview that elaborated on the motivations behind their actions, shown in Appendix A.

The survey asked participants about the categories and motivations discovered through the interview process. This broader data set provided information to investigate how motivations affect the network at large.

The Team used distribution models as a form of diagnostic analysis to understand the motivations of the community at large. We found prominent groups and their motivations to highlight why the community communicates in the way that they do.

3.2.3 Existing Tools

Objective: Understand existing collaboration tools and their benefits

The purpose of this objective is to identify and compare existing tools that enhance collaboration. This information tells our group what already exists, allowing us to take inspiration from other sources.

We needed to understand the tools actively used within the community. To do this, we asked the interviewees what tools they used to communicate. Throughout the process, we recorded the various tools and software mentioned along with their associated benefits. The accumulated data gave us a window into the types of tools used in the community.

3.2.4 Opportunities to Promote Collaboration

Objective: Identify Opportunities for promoting collaboration between actors

The purpose of this objective is to look to the future and identify areas of interest for tools, initiatives, or research. To do this, we investigated three questions: How could a tool appeal to the market? What areas would benefit most from a tool? What groups would be most receptive to a tool?

To investigate these ideas, we created a marketing model as a form of predictive analysis. A marketing model maps a group of "customers" to find what would most appeal to them. For our purposes, we chose to use a Quality Function Deployment (QFD) model — also known as the House of Quality — to analyze the SDN. More information on the House of Quality can be found in Appendix F. QFD can be applied to the "Socio-psychological" aspects of the community, investigating "feelings of employees and customers, satisfaction, management styles, communication, etc." (Wolniak, 2018). The QFD model investigates how a target community views products or services by reporting requirements for consumers and engineers to create the ideal product. It also maps existing tools and their usage. The model shows how "customer requirements relate directly to the ways and methods companies can use to achieve those requirements" (Bautista, 2020). This will link community needs to possible outputs, allowing Growing Pathways to create tools in the future, or identify existing tools to leverage to facilitate new connections.

The House of Quality method relies on two data sets: Consumer Attributes (CAs) and Engineering Designs (EDs). The CAs are the features or qualities of a tool that individuals seek in tools. This data set was collected from the interviews and surveys. The interviews revealed the features of the tools that individuals prioritized, and the survey listened to the perceptions of the community at large. The EDs are the internal factors, controlled by the creators, to construct the required output. The EDs can be modified depending on what the creators want to investigate, so we used the motivations found from the interviews. By marking the intersections between these factors, we got a big-picture view of the existing tools, and a path to take for future steps.

3.3 Challenges and Limitations

One obstacle faced by our team was the uncertainty surrounding the first Action University Conference. Since there was no previous participant data available, the team was unsure who would attend and what groups were interested at the beginning of the project. Our group addressed this uncertainty by shifting our focus away from the conference itself. Rather than aim to present at the conference deadline, we used the event and its participants to gather more

data. Additionally, our group gathered data from sources external to the conference. This will expand our access to more data points, instead of limiting our input from one group.

Due to the COVID-19 pandemic the team worked remotely from Worcester, MA. Tools for remote interviews and surveys exist and were heavily utilized to collect the required information.

Due to our “Snowball” surveying technique, it was challenging to contact extremely isolated individuals and organizations, an essential aspect of the map. To counteract isolation the team artificially began a snowball survey within external groups so that further connections could be contacted.

Finally, the team has researched how prior IQP teams have constructed projects out of the Growing Pathways mission. By researching their projects and talking to past team members, the current team identified a lack of quantitative data. Previous teams struggled through using entirely open-ended interview questions. They discovered that each interviewee’s response was too specific and made connecting their responses difficult. Therefore, the current team decided to collect more quantitative data through surveys rather than interview results. We directly analyzed the quantitative data from the surveys to create our final assessment.

4 Findings and Analysis

In the findings chapter, we will discuss the prominent groups within SDNs and how they are motivated to collaborate. We also discuss how the different motivations affect the network and what obstacles are present. These findings will help us discuss how a tool could benefit the community by appealing to their motivations while avoiding common obstacles.

4.1 Interview Findings

From our interviews, we identified several themes and trends, which we then used to inform our surveys. To analyze our interviews we created Code Keys, which define important topics revealed through interviews and list what each interviewee said about the topic. Trends were then identified from this table. The complete table of keys and trends can be found in Appendix G. This method of information gathering has its limitations, however, because of our small sample size. As a result, we must be cautious about how well these views represent the broader community.

Terminology

When conducting interviews, we sought to identify what word choice was most clear for concepts we wished to ask about on our surveys. We found that the term “focus” did not convey the meaning we were hoping for. The term was too vague and abstract. To account for this, we shifted our vocabulary to use the word “role” to describe the actions of an individual within an organization.

Prominence of Leaderships

We found that all the interviewees’ roles directly related to “leadership," either working as leaders, advising leaders, or doing research on effective leadership strategies. We were skeptical if this was representative of the broader community. Because all our subjects came directly from the Action University, a leadership conference, so we decided that this correlation is likely not true for the whole community. We must be cognizant of this when applying interview findings to the border population.

Personal Connections

We discovered that individuals consider connections to be much more personal than we had expected. Interviewees said that they found personal connections to be as important as professional connections. Gertrud Sol describes this as “professionally casual," where a professional relationship does not inhibit a personal connection. Frederick Lassen describes this as an “emotional motivation” to connect, where the meaningful connection brings value to their communication. However, this priority may not be representative of the whole community, due to the previously mentioned sampling bias. As Gertrud explains, her personal inclination is specific to her mindset, while others “want the skillset” first.

Sustained Collaboration

Due to the long-term nature of sustainable development projects, collaboration that seeks to advance them must be similarly long-term. As Puola Helth describes, current leadership training fails to emphasize this long-term mindset. We found that many interviewees noted that buy-in from higher-ups is necessary to ensure the sustained communication needed for it to be effective. Without this high-level support, collaborations are cut after a project is completed, and the benefits never fully embraced.

4.2 Failure to Map Social Networks

While collecting surveys, we discovered a trend: most individuals who took the survey did not send or receive it from another person. This meant that we could not collect data on how people are connected to form our network map and social network analysis. We also were unable to use snowballing sampling to find more people to send the survey to. People also did not see themselves as being part of any networks, listing no groups of people that they work consistently with.

To help supplement the lack of responses, we attempted to cold email people who worked in companies that were part of official collaborative groups. We used databases such as State of Green to find over one hundred companies with similar focuses on sustainability. We emailed them, informing them of our project and what we were hoping to gain, and were only able to get three more responses.

We found that people were not motivated to take our survey because they had no apparent incentive to contribute. Without a prior personal connection, participants did not see a social or financial benefit to fill the survey out. This further emphasizes the significance of personal relationships within SDNs. It also raises a key question: How to form new personal relationships where they do not already exist?

From our data it was apparent that people did not view themselves as groups, but rather individuals that are working together. People were unwilling to share data of others they had worked with in the past. People also did not seem to be familiar with the concept of being part of a “network”. Most respondents did not mention anything about groups that they believed to be part of, even when we found them through an official network. This may have been a question bias, resulting in lack of answers.

4.3 Survey Analysis and Findings

The findings from the interviews informed the survey. The data produced by these surveys was analyzed through descriptive, diagnostic, and predictive models as described in the methodology chapter. To describe the SDN, we investigated the distributions of different groups and roles that exist. For our diagnostic analysis of the SDN, we will identify the distributions of motivations and obstacles that formed the descriptive model. Finally, we predicted market demands using the House of Quality model to analyze existing tools and their features.

4.3.1 Descriptive Analysis

To describe and observe the SDN, we initially planned to create a social network map, a powerful tool that visualizes trends in large data sets of connected items, as explained in Appendix D. However, we found that our data set was not large enough to utilize this tool. We believe this to be because individuals did not feel comfortable sharing and spreading the survey to others, preventing us from listing their connections to other respondents.

Through our interview process, we were able to identify some defining characteristics of networks worth investigating in the survey to see how they described the network.

Defining Sustainability

While Conducting interviews, we found that not everyone in Denmark had the same definition of "sustainable projects." Using our survey, we collected responses on how people working in sustainability define it.

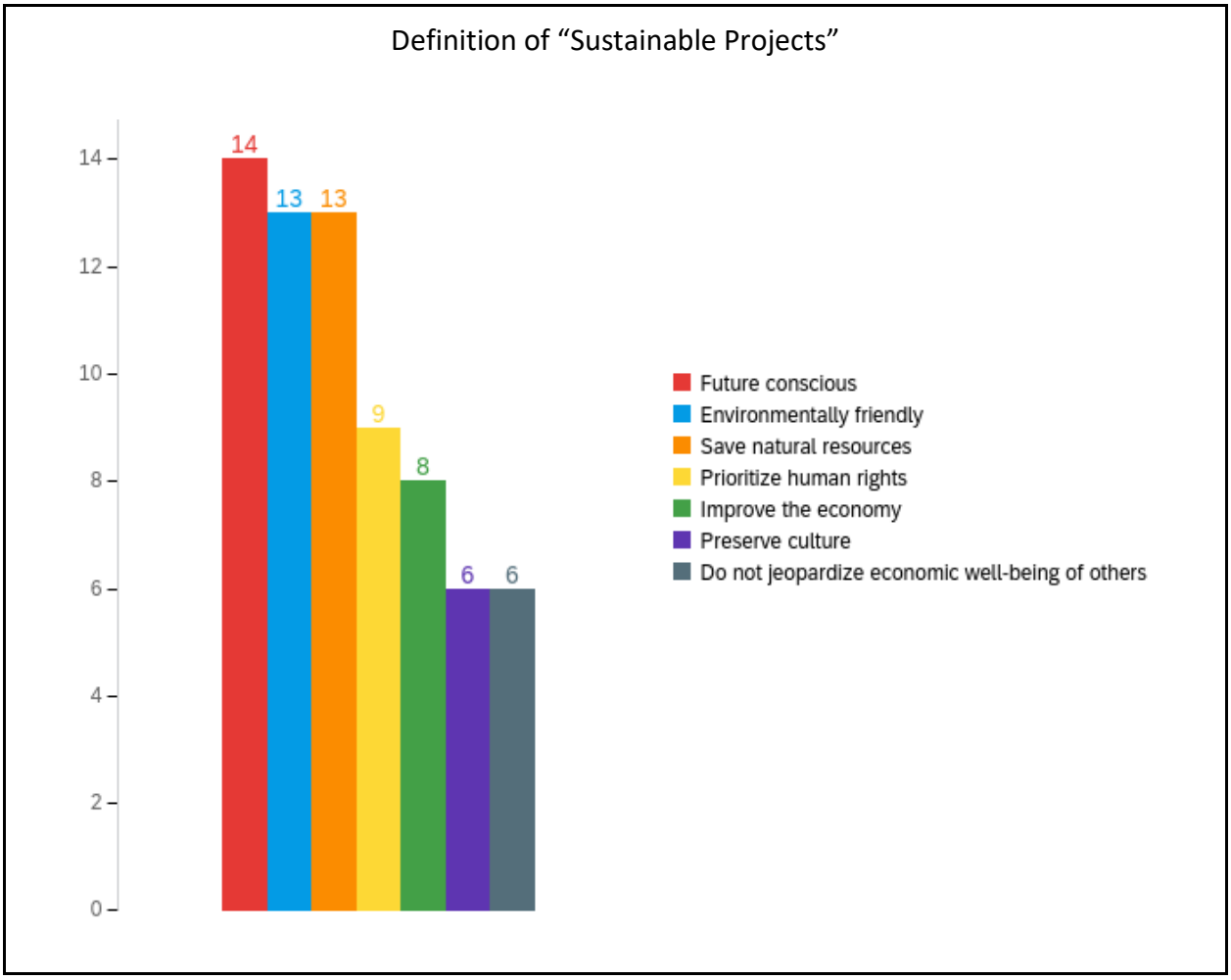

Figure 2: Perceived Definitions of Sustainability

As shown in Figure 2, we found that most people described sustainable projects to be future conscious. Beyond that, many believed that sustainable projects mainly referred to

environmental projects that save natural resources rather than projects that relate to human affairs, such as culture and finances.

4.3.2 Diagnostic Analysis

Diagnostic Analysis aims to identify the underlying motivations and influences that cause the formation of the data set. To investigate this, we focused on the group distributions within the data. Group distributions showed us the prominent groups and motivations within the network.

Distribution

Distribution modelling is the process of calculating the proportions of certain groups or factors within a data set. In our case, we are calculating the distributions of motivations and obstacles within the sustainable development community by asking survey participants about what motivates them to collaborate and what inhibits them from doing so.

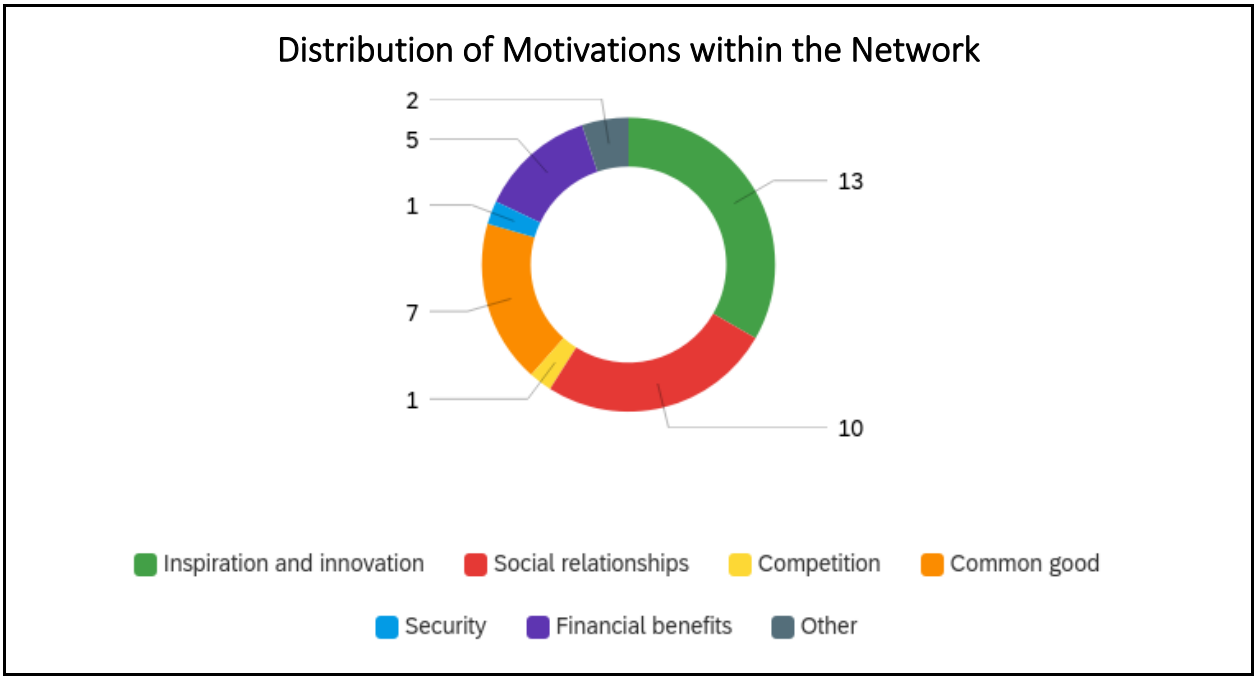

Figure 3: Common Motivations in the Community

Figure 3 reveals the most common motivations within the network. We found that the driving forces behind collaboration are to pursue Innovation and Inspiration, to create Social relationships, and to contribute to the Common Good. This set of key motivations reveals an altruistic approach to collaboration within the community, together making up 75% of the responses. Comparatively, competitive and financial goals make up around 15% of the responses.

Our research also investigated how people evaluate their collaborations. We wanted to find how people define a successful collaboration to know what outcomes a tool could support.

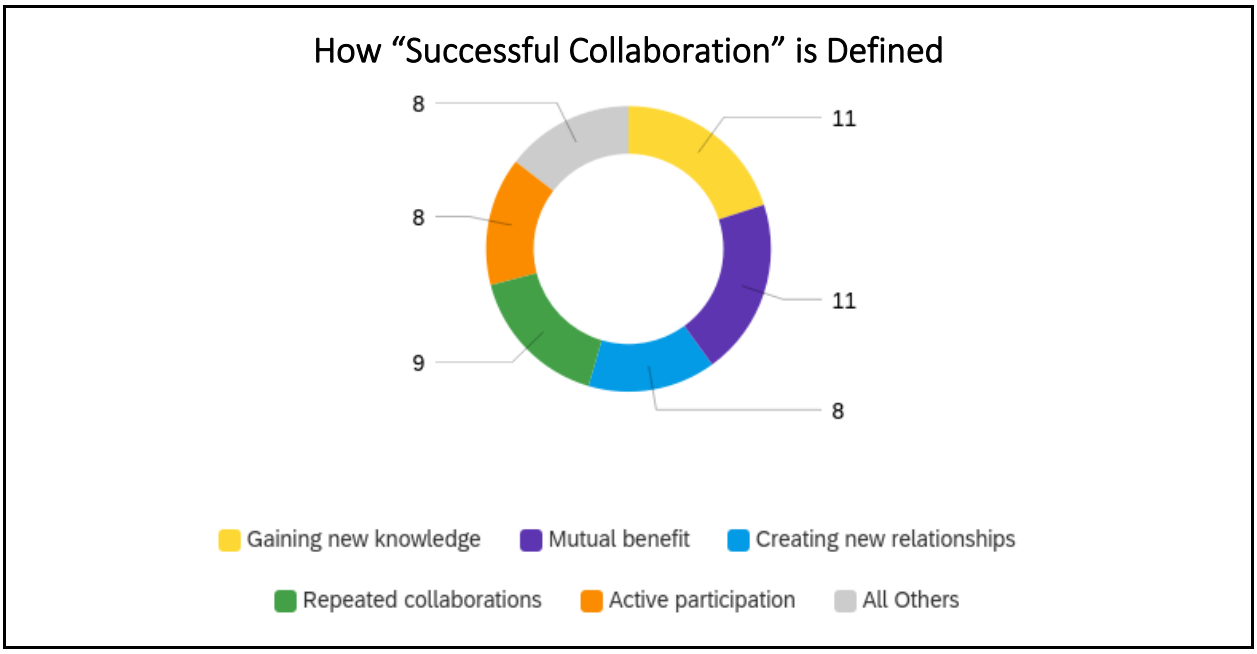

Figure 4: How Successful Collaboration is Defined in the Network

Figure 4 shows how the network defines a “successful collaboration.” We examined this data to gain an insight into how people see value in their connections. In this chart, social benefits, including making new, mutual, and repeated connections, make up the most prominent groups. Many responses emphasized the importance of mutual benefit and active participation. These values show that collaboration is an active, and therefore time-consuming action. This emphasis on equal contribution to collaboration reveals the underlying causes behind some of the obstacles to collaboration within SDNs.

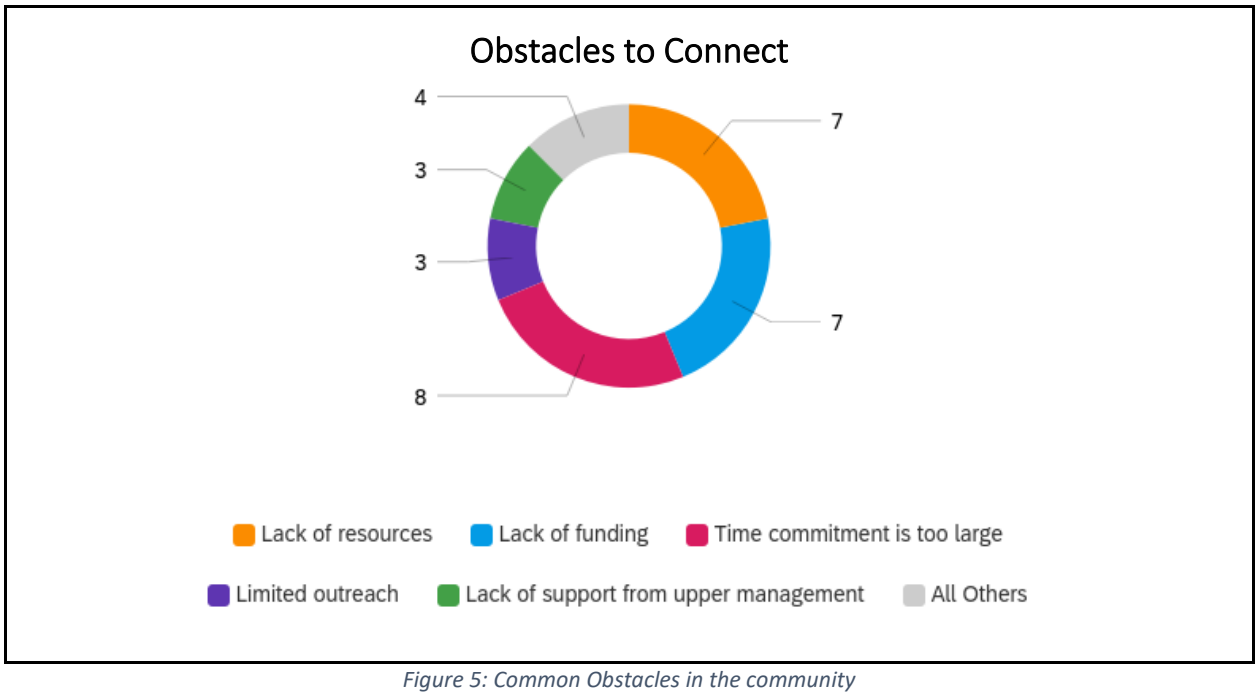

Figure 5: Common Obstacles in the community

Figure 5 shows that most obstacles arise from a lack of time, funding, and other resources, which is a result of the high input cost of collaboration. As Figure 4 showed, for a connection to continue, both parties must contribute meaningfully and actively. This increases the commitment required to collaborate, hindering communication in the community.

The distribution highlights a resource deficiency in the network. It is impossible to meet the high standards that define a successful collaboration without high resource investment. Figure 3 shows that individuals also do not prioritize the financial benefit of collaboration. This makes it hard to justify putting additional resources into collaboration because the most prominent outputs are the social and innovative aspects of the process, values much harder to quantify.

4.3.3 Predictive Analysis

Our primary tool for predictive analysis is the House of Quality. To create the House of Quality, we needed three data sets: The set of CAs and weights, the set of motivations and correlations, and the set of existing tools and user perceptions.

We retrieved the set of CAs through our interviews. We generated a list of tools with their associate CA, seen in the left column of Figure 6. We condensed these CAs to create a horizontal axis for our House of Quality. For each CA, we calculated the average relative-importance of each feature through a mean calculation, shown in the “weights” column of Figure 6.

To create the vertical axis, we leveraged the motivations found from the interview participants. These motivations acted as comparisons to the CAs to determine which CAs best appealed to the motivations of the existing members. We then generated the correlation matrix — the central area of the house, comparing how the motivations correlate with the CAs. Finally, tool-comparisons are ranked on the right side of the table. Figure 6: House of Quality shows the completed model.

Strong Effect	◉
Moderate Effect	○
No Effect	
Moderately Poor	□
Poor Effect	■

	Weights	Social Relationships	Financial Benefits	Security	Innovation & Inspiration	Competition	Common Good	In-Person Meetings	E-Mail	Social Media	Team-Based Platforms	Private Messaging	Virtual Meeting Tools	Educational Classes	Exercise Sessions	Crypto Currency	Virtual Reality
Expressive and Personal	3.2	◉			○		○	4	4	5	4	4	4	5	5	-	4
Professional Appearance	3.8	○	○		□	○		5	5	4	5	4	4	6	4	5	3
Search for New Connections	3.5	◉	○	□	○	◉	◉	6	3	5	4	3	3	5	-	-	-
Informal Communication	3.3	◉	□		○			-	6	6	6	4	6	-	-	-	-
Clear Communications	3.8				◉		○	6	5	6	5	5	5	6	-	-	5
Video Conferencing	3.0	◉		□	○			5	1	1	5	1	5	-	-	-	-
Private Information	3.3	■	○	◉	□	◉	■	6	4	3	3	3	3	-	-	-	-
Recommends Connections	3.8	◉		□	◉	◉	◉	5	3	6	3	3	3	5	3	1	1
Widely Used	4.0	◉	○	○			◉	6	7	7	5	6	6	-	5	3	3
Public User Groups	3.8	◉	□	■	◉	◉	◉	4	2	5	4	3	4	6	5	1	1
Search Users by Experience	4.0	◉	◉		◉	◉		7	2	6	3	4	3	-	5	1	1
Total								53	40	53	46	40	46	33	28	12	18

Figure 6: House of Quality

The House of Quality showcases many aspects of the market demand, so we are focusing our insight on how a tool could appeal to the motivations we discovered.

Important Existing Tools

On the right side of the table, different existing tools are compared by ranking their individual features. This section can be used to identify which aspects of existing tools perform well. We identified the most important motivations behind connections: creating social relationships and Innovating and Inspiring each other. We used these motivations to find features that are strongly correlated with both motivations. We then found that these motivations best align with tools that: provide expressive, personal, and informal spaces or recommend new connections and allow users to search for others.

We examined existing tools to find which had strong traits in these fields. We recognized social media platforms and educational classes to provide these features. This means that social media platforms and educational classes most closely align with the motivations to form new social relationships and gain inspiration from innovation.

Identifying Market Niches

Market Niches are areas where all or most other tools fail to meet the expectations of the community. Using the table of tool comparisons, we can look for rows that tend to have lower rankings, revealing niches that could be targeted by a new tool.

From our analysis, we found that most people prefer in-person meetings because they fulfill all the CAs. From this, we found that there were some niches where tools fell short of the in-person meetings. We identified three niches in the market: tools that recommend connections, tools that keep information private, and tools that have video conferencing.

Recommending Connections

The House of Quality revealed that users were interested in receiving recommendations about potential new connections. This stood out to us because recommending new connections correlated strongly with many of the important motivations we discovered. Particularly, it highly influences innovation by bringing together people who could benefit from their connections, where connections would not be made otherwise. We believe this is a key niche that the tool could appeal to.

Tools that Keep Information Private

Many tools do not prioritize keeping user information private, despite the consumer desire. This is because keeping information hidden hinders the ability to form social connections, as shown by the correlation matrix. This showed that a highly private tool would not benefit the community, despite filling a specific niche.

Video Conferencing

There is a distinct lack of video conferencing tools within these categories. This is because most video conferencing technologies are highly specialized, rather than a broad communication platform. Through our weights, we found that this tool was less desired in the community because this niche is already filled by a small set of existing tools. This eliminates the need to create a new tool to combine video conferencing with other features.

Identifying Key Features

The model can show how existing tools appeal to specific demands using the tool-comparison section to select the top performing features of each tool. This method allows future efforts to create an ideal tool by seeing how each tool is scored on its features. These values can be used to create an ideal tool that implements the structures from different tools that best fulfills specific demands.

5 Conclusions and Recommendations

This project investigated the motivations that cause individuals in SDNs to collaborate by describing existing networks and predicting market demand within SDN communities. Our research aimed to compile the necessary background information for Growing Pathways to make

informed decisions about how they create a tool to facilitate new communications within Denmark's SDNs. Through our descriptive and diagnostic analysis, we uncovered the altruistic influences that motivate connection in the community. Our predictive market analysis, the House of Quality, investigated the demands, patterns, and unfulfilled niches to recommend future efforts to facilitate communication in Denmark.

Limitations

These findings are restricted to the homogenous nature of our data, collected from networks directly connected to the Action University. This restricted our analysis by limiting the population we can extrapolate to. Our final survey was sent to over 600 respondents, but only 13 responded. These limited responses only give us a small sample of the overall population. The survey also had a higher response rate from people connected directly to the Action University, making up 75% of the responses, creating a bias in the data towards their preferences.

We make our conclusions based on the limited scope of responses, and the recommendations follow from these conclusions. Groups should proceed with caution when applying these conclusions to the population. If the research continues, it should account for this lack of data.

5.1 Conclusions

Altruistic Motivations in the Network

To describe SDNs, we concluded that two major groups of motivations influence the network: innovation-based motivations and social motivations. Innovation and inspiration play a major role in forming new connections. Individuals see contributing to the common good, creating new innovative technology, as a net positive beyond financial benefits. Individuals are also motivated to form new social relationships with mutual benefits, arising from active participation. The failure of our snowball sampling biases our population towards leaders, or those who work with leaders, in sustainable development. This makes the conclusions difficult to project outwards onto SDNs at large. Any future efforts to facilitate communication within this section of the community should market the opportunity to form new relationships and focus on providing that service.

We recommend that this focus on altruistic motivations should form the foundation of future efforts to foster collaboration. Tools should create spaces for social relationships to form and where innovation can blossom. This should be done by keeping the platform informal and unrestricted, allowing users to bring their creativity to it.

Market Niches

Through our House of Quality, we concluded that there were four unfulfilled market niches, where there is a potential for new tools. These niches arose from strong consumer desire for certain attributes, without tools fulfilling these desires. These four major niches we identified are:

- Allow users to search for new connections
- Keep user information private
- Recommend new connections to the user
- Allows the creation of public user groups

These niches highlight potential targets for new tools in the market, so we recommend that Growing Pathways pursues tools that emphasize these features to best match the desires of the community

Benefits of Social Media and Educational Classes

Our predictive marketing analysis concluded that existing tools meet many of the desires expressed by respondents by addressing the most important consumer attributes while still motivating collaboration. Social media and educational classes were particularly strong in the sections that mattered most to the respondents: recommending new connections, providing access to the public, and searching for new connections by experience.

When considering creating new tools, we recommend using successful aspects of other tools that already exist. Social media is a great platform for social relationships because it recommends connections and allows users to search for new ones. This constructive platform is a prime starting point for a new tool that focuses on innovation and inspiration among peers in the network. One concern we had was about the quality of connection formed by Social Media. Our market analysis did not account for connection strength, making it hard to assess. Educational classes also align with motivations to innovate and inspire. A learning platform appeals to users' desires to gain new knowledge from connections, fitting directly into the major motivations of collaboration.

Lack of Resources in SDNs

Our diagnostic analysis concluded that the most common obstacle in the community is a lack of resources — through funding, time, or others. This obstacle arises from the emphasis on active and innovative collaborations. Since many people define a successful relationship by the effort put in by both parties, one-sided connections are not viewed as successful.

For a tool to see widespread usage, we recommend that it must not require a prohibitive time, resource, or funding investment to use. A tool could also appeal to non-traditional sources of resources like crowdfunding and open-sourced projects. These participatory methods also form social connections by bringing people and resources closer together.

5.2 Possible Tools

Based on these conclusions, the team generated some sample platforms that could fulfill market demands, match background motivations, and avoid common obstacles, shown in Table 3. These ideas represent how our conclusions can be used to inform future tool creation. Future tools should follow the motivations and desires of consumers, while avoiding the obstacles that inhibit them.

Table 3: Sample Solutions from Conclusions

Input Factors	Solution
Organizations lack the time and resources required to create lasting connections. There is also a desire for a platform with public user groups.	A platform that allows the public to interact with nearby public projects through crowd funding. This project uses a desire to form public groups to address the lack of resources
Innovation and Inspiration are driving motivations of collaboration. Social media has shown to fulfil many market desires	A social media platform showcasing innovative research and public projects. This tool promotes innovation and collaboration through connecting it to social media platforms.
The community most desired a tool that could recommend new connections. The community is also heavily motivated to form new social relationships	A recommendation algorithm could account for professional interested, desired collaborations, or preferred skills. This would simplify the process of finding new connections.
There is a strong public demand for public user groups Groups are also motivated to form new Social Relationships	A social media platform, like LinkedIn, could be used to focus attention on teams and public groups over individuals. This platform could encourage people to join professional groups through a motivation to connect with a community

5.3 Future Steps

Future work could expand the sample population of the surveys, so that findings can be applied to the wider community as the lack of participation in our methodology was a severe limitation. These efforts could pursue social network maps to better describe the network and provide valuable insights into its structure, but future work requires a different methodology for collecting the connections between actors. The survey sampling method used in this project was not conducive to sharing personal information.

New research must dig deeper into how these general findings can be applied to more specific areas of investigation. Within each broad category of motivation, we are unsure of what sub-categories exist and how they might affect individuals. Future efforts could investigate how people view and define innovation in the community, to show how a tool could emphasize these topics when connecting people.

It is also important to uncover what makes a tool appeal to the specific consumer attributes. We recommend that future tools should encourage the innovation and inspiration within their communities, but our data does not conclude how a tool could accomplish this. The tool should also be intuitive to make it less time consuming, avoiding stretching resources thinner. Time was a major constraint of an individual's motivations, so it is vital to create a tool that does not require a large up-front commitment in time or other resources.

Passing on our Data

The data and sampling methods we used can be useful for future teams to understand the information that has already been collected on the target groups. This way, they can build off our knowledge base rather than repeat work that we have already done. The survey data could also be valuable to analyze in different contexts in the future. We also plan to pass our interview trends and data to later groups. These trends will allow later groups to follow the findings of the interviews.

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Appendices

Appendix A: Interview Questions

Interview Consent Form

- Would you feel comfortable if we record this interview? The interview will not be posted, it will only be viewed by the team.
- Do you give us permission to refer to your responses in our final report? At any point, you can let us know if there are any statements that you want to keep confidential or anonymous.

Interview Questions

Questions about individual/organization

First, we are hoping to get an understanding of your professional role in your field, and what your organization focuses on. We really want to know what you work on and who you work with.

1. Do you work for an organization?
    a. **[Yes]** What does your organization focus on?
        i. Can you narrow it down to a few keywords?
2. What is your focus/field of work [within your organization]?
    a. Is there a phrase rather than "focus" that would have made that question more clear?
3. Are you/your organization a part of a larger collective/cluster/network of other organizations?
        i. Name?
4. Where do you primarily operate?
    a. Is this the same for your projects?
5. Can you name any specific project(s) that you have worked on in the past year?

Questions about Collaborations

We are hoping to talk to you a little more about your **[your projects/your work]**. We want to get a more specific understanding of how and why you communicate and collaborate. This will help

us to better understand the inner workings of sustainable development projects and how communications are conducted.

1. Are there any other groups that are involved in your work?
    a. Are these common partners, or are they unique to the project?
    b. Do any of these groups have a primary focus different from your company's?
        i. How would you classify their focusses? keywords?
        ii. How specific are you in wording of the focus of organizations you are trying to connect with? [e.g. looking for groups focusing on air quality vs. groups focusing on air traffic emissions.]
    c. How you use to **describe** relationships with other organizations/groups?
        i. What **word choice** would you use (Ex. collaboration, coordination, connecting with, partnering...)? We would like to know what kind of vocabulary would be most clear for our tool.
        ii. How do you measure the success/importance/**value** of your communications? {How Long connection lasts, frequency of communication, how informative}
    d. Of the groups that you worked with; we would like to ask more about how these connections were formed.
        i. Who contacted who? Did an individual reach out, the organization, a third party?
        ii. What form of communication did that take?
            1. Did any tool facilitate this connection? *Ex. Online messaging board, Word of mouth, online job searches, friends and family, advertisements?*
            2. Is seeking out a partnership in this way common?
    e. Are there any roadblocks that inhibit your work?
2. Do you feel motivated to grow your network of connections?
        i. Why or why not?
            1. Do you see your opinion as representative of the community as a whole?

a. **[No]** What do you think the general perception of the community is?

ii. Are there any tools that you use to grow your network of connections?

iii. Are there any tools that you would want to have?

b. Do you feel like you compete with other groups for resources?

i. If so, do they have similar goals?

ii. Would you consider communicating or collaborating with them? Why/why not?

3. What groups have a vested interest, or would be impacted by your work? E.g. Residents, environmental groups

a. Have they given you feedback?

b. Do you have ways to communicate with them?

i. **[no]** Is a tool to facilitate this communication something you would be interested in?

Questions about the Action University

1. What is your connection to the Action University?

a. What are you hoping to gain from your engagement with it?

b. Are you planning on attending the conference when it becomes possible to carry out?

c. What aspects of the conference interest you most?

d. How did you hear about the Action University?

2. Have you ever worked with any people or organizations around or connected to the Action University in the past?

a. [Yes] – Has the relationship led to any new connections?

i. How did the connection(s) form?

ii. What did you do with the connection?

iii. How long did it last for?

Questions about the 6 P's

1. Are you familiar with the 6 P's?
    a. [**Yes**] How did you get to know them?
    b. [**no]** [Go over each: People, Place, Participation, Prosperity, Peace, Planet**.]**
2. Do you actively use the 6 P's within your work?
    a. **[Yes]** Which does your group most closely represent? [Use each P they say they work with]
        i. How do you work with these P's?
        ii. What projects have your done to promote the 6 P's?
        iii. Do you share the 6 P's framework with collaborating groups?
        iv. Are they a useful framework for your group?
        v. Are there any P's that you think are important, but that are missing or weak in your work?
    b. **[No]** [Explain 6 P's]
        i. Which P's do you think could be applied to your work?
        ii. Would you consider using the 6 P's as a framework in future discussions?

Conclusion

1. Thank you for your time!
    a. We will respect your data completely. These interviews will not be made public, and if there is any sensitive information, we can keep it confidential. If there is any information disclosed during this interview that you would like to keep confidential, please let us know

Our Next steps:

- Analyzing interview results
- Forming and distributing questionnaire for tool.
- Analyzing responses to advise suture teams on what needs exist and direction for future tools.

Are you interested in being contacted during our next steps, so that you can be included in our next stage of analysis to inform the tool?

Appendix B: Survey Questions and Consent Form

Survey Consent Form

This first set of questions is about your network of connections. In this case, a "connection" is a professional relationship with another person outside of your organization. Your "network" is the connected individuals and organizations that you communicate or collaborate with when working on projects.

These questions are extremely important for our research process as we will use your responses about yourself and your connections to reach out and expand our results. Please note that we respect your privacy. None of your responses will be shared publicly, and they will only be used for research purposes.

Do you consent to the use of your personally identifying information in this research?

☐ Yes

Survey Questions

Q49 What is your name?

_____

End of Block: Block 10

Start of Block: in-org

Q3 Do you work for an organization?

- ○ Yes (1)
- ○ No, I work independently (2)

End of Block: in-org

Start of Block: Organization

*

Q4 What is the name of your organization?

_____

Q9 What is the size of your organization?

- ○ Under 10 People (1)
- ○ 10-50 People (2)
- ○ 50 - 250 People (3)
- ○ 250 - 1000 People (4)
- ○ 1,000 - 10,000 People (5)
- ○ 10,000 - 100,000 People (6)
- ○ More than 100,000 People (7)

Q10 What category does your organization fall under?

- ☐ Health Care (1)
- ☐ Government (2)
- ☐ Research (3)
- ☐ Construction (4)
- ☐ Clean Air, Water, or Soil (5)
- ☐ Energy (6)
- ☐ Climate Change Adaption (7)
- ☐ Culture/Arts (8)
- ☐ Human Resources (9)
- ☐ Education (10)
- ☐ Other (please specify) (11) _____

Q12 Is your organization a part of any official collaborative groups?

- ○ Yes (please specify) (1) _____
- ○ No (2)

End of Block: Organization

Start of Block: Sustainability

Q40 At this point in the survey, we want to gauge your perception of the word "sustainability"

Q39 For you, what topics are included within the idea of "sustainable projects"

- ☐ Projects that are future conscious (1)
- ☐ Projects that preserve culture (2)
- ☐ Projects that are environmentally friendly (3)
- ☐ Projects that improve the economy (4)
- ☐ Projects that prioritize human rights (5)
- ☐ Projects that save natural resources (6)
- ☐ Projects that do not jeopardize economic well-being of others (7)

End of Block: Sustainability

Start of Block: Snowball Sampling

Q50 Did A collogue send you the link to this survey? If so, who?

_____

End of Block: Snowball Sampling

Start of Block: Motivations

Q18 Questions about your Motivations The next set of questions relates to your motivations to collaborate. This will inform us how to best help you with our research.

Q19 How strongly do you agree with this statement:
"I am motivated to form new connections and expand my network"

- ○ Strongly agree (1)
- ○ Somewhat agree (2)
- ○ Neither agree nor disagree (3)
- ○ Somewhat disagree (4)
- ○ Strongly disagree (5)

Display This Question:

If How strongly do you agree with this statement: "I am motivated to form new connections and expand...! = Strongly disagree

Q20 What, from this list, motivates you to collaborate? (please select all that apply)

- ☐ Social Relationships (1)
- ☐ Financial Benefits (2)
- ☐ Security (3)
- ☐ Inspiration and Innovation (4)
- ☐ Competition (5)
- ☐ Common Good (6)
- ☐ Other (Please Specify) (7) _____
- ☐ None (8)

Q21 What makes a collaboration "successful" to you? (please select all that apply)

- [ ] Increased Profit (1)
- [ ] Mutual Benefit (2)
- [ ] Creating new Relationships (3)
- [ ] Repeated Collaborations (4)
- [ ] Gaining new Knowledge (5)
- [ ] Active Participation (6)
- [ ] Other (Please Specify) (7) _____

Q37 On average, how many new connections do you maker per year?

	0 5 10 15 20 25 30 35 40 45 50
Number of Collaborations per Year ()	

End of Block: Motivations

Start of Block: Communication Tools

Q23 What Obstacles hinder your ability to connect with other groups?

- [ ] Lack of Motivation (1)
- [ ] Limited Outreach (2)
- [ ] Lack of Funding (3)
- [ ] Lack of Support from upper management (4)
- [ ] Geographical Isolation (5)
- [ ] Difficulty Reaching out (6)
- [ ] Projects do not require motivation (7)
- [ ] Time commitment is too large (8)
- [ ] Lack of resources (9)
- [ ] Tools are not targeted to me (10)
- [ ] Other (Please Specify) (11) _____

Q24 What tools do you use to communicate with other groups? (Select all that Apply)

- [ ] In-Person Meetings (1)
- [ ] E-Mail (2)
- [ ] Social Media (ex: LinkedIn, Facebook) (3)
- [ ] Team-Based Platforms (ex: Slack, Microsoft Teams) (4)
- [ ] Private Messaging Apps (ex: Signal, Telegram, WhatsApp) (5)
- [ ] Virtual Meeting Tools (ex: Zoom, Skype) (6)
- [ ] Educational Classes (ex: workshops, cooking classes) (7)
- [ ] Exercise Sessions (8)
- [ ] Crypto-Currency Platforms (ex: 1Hive) (9)
- [ ] Virtual Reality (10)

Q45 For each feature listed below, how helpful are they in the tools you use?

	Not helpful at all 1	2	helpful 3	4	Extremely helpful 5
Allows users to be expressive and personal ()					
Has a Professional Appearance ()					
Allows users to search for new connections ()					
Allows for informal communication ()					
Provides an easy and clear way to communicate with others ()					
Video conferencing ()					
Keeps my information private ()					
Recommends new connections ()					
Is Widely Used ()					
Allows creation of user groups ()					
Search for people by expertise ()					
Other (Please Specify) ()					

Display This Question:

If For each feature listed below, how helpful are they in the tools you use? [Allows users to be expressive and personal] > 3

Carry Forward Selected Choices from "What tools do you use to communicate with other groups? (Select all that Apply)"

For this question, the participant will be asked to fill one matrix per feature that they said was valuable (> 4)
Q26 For each tool you selected, how strongly do you agree with the statement:

"This tool allows users to be expressive and personal"

	Strongly agree (1)	Somewhat agree (2)	Neither agree nor disagree (3)	Somewhat disagree (4)	Strongly disagree (5)
In-Person Meetings (x1)	○	○	○	○	○
E-Mail (x2)	○	○	○	○	○
Social Media (ex: LinkedIn, Facebook) (x3)	○	○	○	○	○
Team-Based Platforms (ex: Slack, Microsoft Teams) (x4)	○	○	○	○	○
Private Messaging Apps (ex: Signal, Telegram, WhatsApp) (x5)	○	○	○	○	○
Virtual Meeting Tools (ex: Zoom, Skype) (x6)	○	○	○	○	○
Educational Classes (ex: workshops, cooking classes) (x7)	○	○	○	○	○
Exercise Sessions (x8)	○	○	○	○	○
Crypto-Currency Platforms (ex: 1Hive) (x9)	○	○	○	○	○
Virtual Reality (x10)	○	○	○	○	○

Display This Question:

If For each feature listed below, how helpful are they in the tools you use? [Has a Professional Appearance] > 3

Carry Forward Selected Choices from "What tools do you use to communicate with other groups? (Select all that Apply)"

Q34 Is there any functionality missing from available tools? *Optional

_____

Q35 What is one thing that regularly inhibits your ability communicate using existing tools? *Optional

_____

End of Block: Communication Tools

Start of Block: The 6 P's

Q36 For each topic below, how strongly do you agree with the statement:

"This topic describes the focus of my work"

	Strongly agree (1)	Agree (2)	Somewhat agree (3)	Neither agree nor disagree (4)	Somewhat disagree (5)	Disagree (6)	Strongly disagree (7)
Ending Poverty and Hunger, ensuring all humans can achieve their full potential in a healthy environment (1)	○	○	○	○	○	○	○
Fostering a perpetually dynamic, complex system with continuous adaptation to promote communication (2)	○	○	○	○	○	○	○
Creating a spirit of strengthened global solidarity, focused on the needs of the poorest and most vulnerable (3)	○	○	○	○	○	○	○
Fostering peaceful, just, and inclusive societies. (4)	○	○	○	○	○	○	○
Protecting the planet so it can support the needs of the present and future generations. (5)	○	○	○	○	○	○	○
Ensuring that all human beings can enjoy prosperous and fulfilling lives (6)	○	○	○	○	○	○	○

End of Block: The 6 P's

Appendix C: Sponsor Information

Dr. Oleg Koefoed is the cofounder of Growing Pathways, an organization focused on promoting sustainable development through communications platforms and expert guidance. Growing Pathways hopes to inspire businesses to invest in sustainable development and promote collaboration between leaders. Koefoed hopes that businesses will see investing in sustainability to be financially rewarding, integrating it into the norm of businesses. This idea is supported by Gomez-Trujillo et al. in an article reviewing corporate interest in sustainable ideas. This paper reviewed a set of 156 articles to determine the under-arching causality between sustainability and profit. The study found evidence of a bidirectional correlation between the three factors of sustainability, reputation, and financial performance (Gomez-Trujillo, 2020). This viewpoint shows that promoting sustainability in business circles can be a viable way to increase financial success and vice versa.

Growing Pathways has also been highly involved with green spaces in Copenhagen since as stated above, their goal is to improve nature and human relations. GP has worked with popular businesses such as the world-famous restaurant Noma and the Copenhagen Maritime Community Gardens to develop and invest in plans that meet citizens in a life-enhancing place and invite all species of life to equal importance.

Growing Pathways" most popular project, Nature I Byen (NiB) (Nature in the City in English), is a program designed to broaden urban nature awareness with equal sponsors Growing Pathways, LIFE Exhibitions, Miljøpunkt. Through cultural mapping, the team has been working to grow a self-organizing network of professionals and volunteers engaged in urban nature-related activities in the city. The network feeds into a public website (http://naturibyen.com), where the broader audience can see activities, events, and articles about urban nature.

The website includes a map for citizens and tourists in which a visitor can discover urban nature for an individual or group to discover recreational activities such as kayaking and exercising, socialize with groups, discover wildlife and urban farming such as urban beehives, areas of botanical and community gardening, and areas dedicated to nature meditation. The calendar provides volunteer opportunities, family events, festivals, exhibitions, and networking events for professionals. There are pages for researchers looking for people to participate in citizen science, whether on social science or physical ecology levels.

Appendix D: Social Network Visualization Software

To generate a visualization, a set of mapping software is available. All these tools provide similar functionality. All are capable of graphing nodes, graphing connections, and performing analysis. Social Network Visualizer was the tool we selected. Data can be entered into these tools as adjacency matrixes, which represent the presence and strength of a connection between two individuals.

Here is the list of options:

Gephi

Gephi is a free open-source visualizer for social networks, capable of producing metrics for centrality, degree, betweenness, and closeness. Additional information can also be displayed through the colors of nodes The Open Graph Viz Platform (The Open Graph Viz Platform).

EgoNet

EgoNet is another social network visualizer that has an emphasis on integrating questionnaires and surveys into the software itself and then creating visualizations based on that individual response. Each social network can then be combined into one large visualization (Egonet, 2013).

Social Network Visualizer (SocNetV)

SocNetV is another free and open source software that provides standard functionality in terms of network visualization and metrics. Little stands out about this software but appears well documented and robust (“Free and Open-Source Tool”.)

Appendix E: Code Keys

Topic	Trend	Reasoning
Organization Role	Many are involved in public works or health services	Over half worked in public services (Rikke and Fred), or for health systems (Gertrud and Hanne).
Personal Role	All focus on the topic of leadership in Sustainable development	Most had a specific focus on leadership and leadership training. Some were leaders, some trained leaders, some researched leadership, etc.
Projects	Projects focus on developing skills, over physical creations	Many projects involved research, focus groups, and workshops to train people and gain information.
Network	Each person was in specialized networks. they do not overlap often except when through the Action University	Each person mentioned a different "network" that they were a part of. Despite being connected, they did not share an official network, except for the "City of Copenhagen"
Collaborations	Collaborations are done with a specific focus in mind. They reach out based on requirements.	Most people did actively search for new connections, but most searched based on the need for a specific project. Some people reached out because they were interested in another group's projects.
How Connections were made	All members fit into one of 2 groups: **1)** people who like to meet in-person. They enjoy personal meetings, with less structure **2)** people who communicate through online tools, primarily email or social media (LinkedIn, Facebook)	Seems to be a distinct separation between the two groups. Most said that their communications methods worked well for them. Common Online tools: **Email**: used primarily for introductions and initial contact **Social Media** (Facebook, LinkedIn) Used to find new connections and reach out, especially younger people **Messaging apps**: used primarily for internal communication. Used once connections are established.
Collaboration Roadblocks	Roadblocks are specific to projects - a large portion of leadership problems arise from rigid systems	Many roadblocks came from the lack of willingness to change or to embrace collaborations from higher ups - could be an interesting point for our tool to consider; how to communicate to leaders
6 P's	Varying degree of knowledge. Of those that knew, there was a positive perception. People who did not know also seemed to connect it to their work	Everyone either knew of, or was receptive to collaboration, few already used it in their work.

Appendix F: House of Quality

Quality Function Deployment is a method of analyzing and appraising tools to improve their quality through informed design decisions. The House of Quality is a specific step in this process used to analyze existing tools and compare them before making changes in production (Hauser & Clausing, 2014).

This article explains more about how to read The House of Quality.

The House is made of 5 main sections: The Consumer Attributes (CAs), Weights, Correlations Matrix, Roof, and Competitor Evaluation.

The CAs are a set of features that the users look for in a tool.

The weights are a set of values that show how important each CA is to the customer. These values are determined through a collection of data from consumers. Higher weights mean that the CA is more valued by consumers.

The correlation matrix is the section of the model that determines how the CAs interact with the Engineering Designs (EDs) of the tool. The EDs are a set of values that are compared to the CAs. The EDs can be changed based on the intent of the model.

The roof of the model determines how the EDs relate to each other.

The competitor evaluations show how existing tools meet CAs.

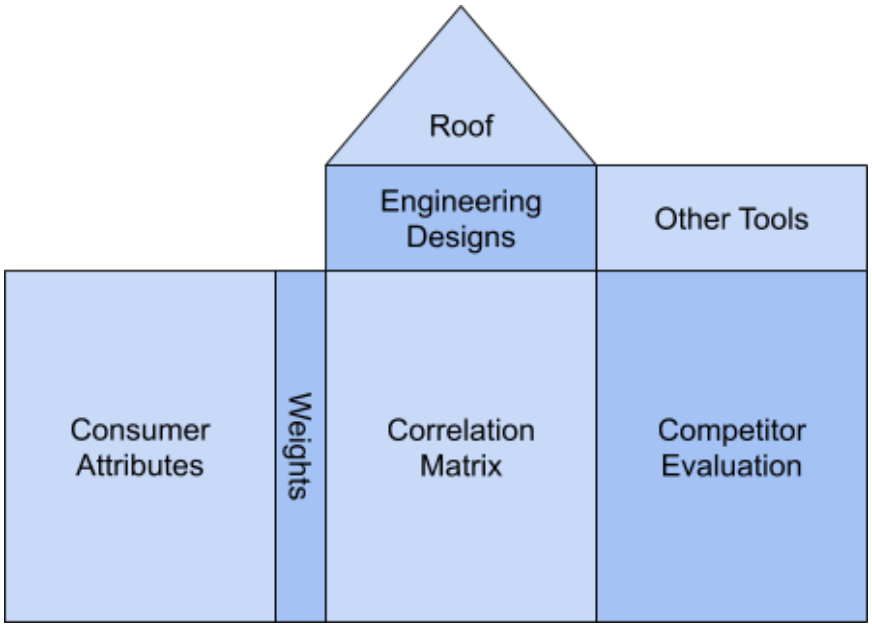

Figure 7: Layout of a House of Quality