



Norwegian University
of Life Sciences

Master's Thesis 2022 30 ECTS

School of Economics and Business

System Change Through Collaboration for Wicked Problems

**The framework *Systems Thinking for Social Change Applied in Practice*
using Action Research for the System of Brewers Spent Grain Handling**

Eva Helene Nagelhus and Fam Leborg
Entrepreneurship and Innovation

SYSTEM CHANGE THROUGH COLLABORATION FOR WICKED PROBLEMS

**The framework *Systems Thinking for Social Change* Applied in Practice using
Action-research for the System of Brewers Spent Grain Handling**

by

Eva Helene Nagelhus and Fam Leborg

Master's in Entrepreneurship and Innovations

Norwegian University of Life Sciences

May 2022

ACKNOWLEDGEMENTS

We want to thank our supervisor Matthew Patrick James Lynch with helping us through this master thesis. And thanks to all the participants who shared their perspectives; Especially, the participants from Arendals Bryggeri, Cernova Industri and Felleskjøpet Fôrutvikling. In the end, we want to give a special thanks to our mentors David Peter Stroh and Simen Knudsen, who generously dedicated their time through monthly meetings with us.



ABSTRACT

This research aims to investigate the design of a framework concerning wicked problems which can successfully carry out systematic change in practice. The methods used were action-based research applying Stroh's framework: Systems Thinking for Social Change to the issue of spent grain handling. Key findings from testing the framework include (1) need for an initial system overview, (2) the importance of mapping and rating the motivation, (3) the process of using the framework should not be linear, and (4) the need for a neutral philanthropic initiator and driving actor taking over the project. The new framework *System Change through Collaboration for Wicked Problems* was created to provide a more general approach of addressing these specific issues related to improving wicked problems. This research shows how actions for small system changes can lead to shifts in the overall system outcome. It also emphasized that more frameworks, research and practitioners of system change are needed to improve wicked problems.

TABLE OF CONTENTS

List of Figures	iii
List of Tables	iv
Definition of Terms	v
1. Introduction	1
1.1. Background and objectives	1
1.2. Case: Spent grain handling	2
1.3. Problem statement.....	4
2. Theoretical Backbone	5
2.1. The context for system change.....	5
2.2. Sustainability in a capitalistic economy	5
2.3. The complexity of wicked problems	6
2.4. System change.....	8
2.5. Systems.....	9
2.5.1. Systems change	9
2.5.2. System change: action and outcome	10
2.5.3. Incremental, structural and transformational system change	11
2.5.4. Businesses and system change	13
2.6. System thinking.....	15
2.7. Methods for system change.....	17
2.8. Research on methods for system change	18
2.9. The framework: <i>Systems Thinking for Social Change</i>	18
2.10 Action-based research	19
3. Methodology	23
3.1. Research case.....	24
3.2. Research design.....	25
3.3. Sample Selection	26
3.4. Data collection and analysis	29
3.5. Validity and reliability.....	32
3.6. Ethnographic personalities.....	33
3.6.1. The researchers - Background, biases and reflexivity	33
4. Findings and Discussion	35
4.1. Overview research process.....	35
4.2. Key reflections research process	41
4.2.1. Stage one: Building foundation for change	41

4.2.2.	Stage two: Facing Current Reality.....	46
4.2.3.	Building understanding through system mapping.....	46
4.2.4.	Building support by bringing the system to life.....	50
4.2.5.	Stage three: Making an explicit choice.....	51
4.2.6.	Stage four: Bridging the gap.....	54
4.3.	Summary of results.....	56
5.	System Change through Collaboration for Wicked Problems.....	58
5.1.	Background of the new framework.....	58
5.2.	Criteria of framework.....	59
5.3.	Structure of framework.....	60
5.3.1.	Stage one - System Overview.....	61
5.3.1.1.	Create a system overview.....	62
5.3.1.2.	Identify and rank motivation.....	62
5.3.2.	Stage two - Actor-interviews.....	63
5.3.2.1.	Interview preparation.....	63
5.3.2.2.	Conduct interviews.....	64
5.3.3.	Stage three – Connect dots.....	65
5.3.4.	Organize information.....	66
5.3.5.	Outline possible solutions.....	66
5.4.	Stage four – Create intention.....	67
5.4.1.	Actor engagement.....	67
5.4.2.	Setting the intention.....	68
5.5.	Stage five – Identify and fill holes.....	69
5.5.1.	Identify and fill holes in solution.....	69
5.6.	Stage six – Make a choice.....	70
5.6.1.	Engage actors in making a choice.....	71
5.7.	Stage seven – Plan implementation.....	71
5.7.1.	Facilitate for action planning.....	72
5.8.	Stage eight (or ∞) - Repeat process.....	72
6.	Conclusion.....	74
7.	Bibliography.....	76
8.	Appendix A: Tables and Figures.....	102
9.	Appendix B: Semi-structured Interview guide.....	120
10.	Appendix C: Consent Form.....	121

LIST OF FIGURES

<i>Number</i>	<i>Page</i>
1. Global Food System Map	8
2. Meadows' (1999) Twelve Points of Intervention	11
3. "What Changes" Model	13
4. The Classic Stakeholder Model.....	14
5. Four Stages of Leading System Change.....	19
6. Spiral of Action-Research Cycles	20
7. Overview map – Current Supply Chain of Spent Grain	25
8. Research Design.....	26
9. Overview – Research Process.....	35
10. System Change Through Collaboration for Wicked Problems.....	61
11. System Map – Brewery.....	107
12. System Map – Flour Producer.....	107
13. System Map – Animal Feed Producer	107

LIST OF TABLES

<i>Number</i>	<i>Page</i>
1. Seven Choice Points for Good Action Research.....	21
2. Study Participants per Actor.....	27
3. The “Why” Question	44
4. The Motivation Map.....	98
5. Hidden vs Exposed Priorities – Key Actors (current solution).....	100
6. Hidden vs Exposed Priorities – All Actors	101
7. Hidden vs Exposed Priorities – Key actors.....	102
8. Hidden vs Exposed Priorities – Pilot Project.....	103
9. Stakeholder in the Spent Grain System.....	104
10. The Iceberg Model	105
11. Mental Model Map	108
12. Understanding Payoffs in the Existing System	110
13. The Case for Changing vs Status Quo	111
14. Polarity Model – Brewery.....	112
15. Polarity Model – Flour Producer.....	113
16. Polarity Model – Animal Feed Producer	114

DEFINITION OF TERMS

System a set of things working together as parts of a mechanism or an interconnecting network.

System change changes between different aspects of the system towards new outcomes and goals. Transformational, not incremental, changes drive the system change.

System actor an individual or group that, in the context of a specific situation, can interact with or are part of the system.

Brewer's Spent Grain the industrial word describes the malt after a brewery has already used it to make beer. In the text, brewers' spent grain is referred to as "spent grain", and shortened to BSG in tables and maps.

INTRODUCTION

1.1 Background and objectives

By the end of the 21th century the earth will reach the point of no return, where the effects of climate change will be irreversible (Aengenheyster, Feng, van der Ploeg and Dijkstra, 2018). If the trajectory of the path is not changed, there is a 90% chance that three billion people will have to choose between starvation or migrating to milder climates (Battisti and Naylor, 2009). Climate change and food security are two of many super wicked problems society is facing today, and these struggles are difficult to solve due to the interwovenness of the systems in which the problems transpire. Due to the complexity of wicked issues (Rittel and Webber, 1973), they can not be solved, only improved by system changes.

Wicked problems can be summarized as highly complex problems that are unstructured, open-ended, multidimensional, and systemic and may not have a concretely defined issue, and thus no known solutions (Rittel and Webber, 1973). Hence, comprehensive systematic change is necessary to radically improve wicked problems (Dentoni, Waddell and Waddock, 2017). Yet, in the world we live in today, the boundaries of the economic systems hinder actors from creating large systemic changes (Jensen, 2006), as the nature of the system is based on growth and not frugal intentions. However, many small systemic innovations in a complex system can ultimately lead to larger system changes which are needed for a paradigm shift. (Meadows, 1999). Therefore, the solution is to bring on systemic changes within the realm of the current economic system, beginning with more realistic systemic changes aiming for a larger outcome.

The actors that want and have the resources to create change in the system need methods to make efforts in reality. There is a considerable amount of research on systems and system change (Foster-Fishman, Nowell and Yang, 2007). In spite of this, research on optimal methods to create system

change in practice are lacking. The current system is hugely profitable to key actors and the lack of comprehensive research processes are disincentivizing research into methods to change the system. The most relevant framework aiming at guiding people to tackle complicated societal issues is presented in the book *System thinking for Social Change*, by David Peters Stroh (Stroh, 2015). The framework is covering several issues, but does not address the issue of gathering actors and defining a specific problem, which addresses two of the core characteristics of wicked problems. Because the framework is not primarily focused on wicked problems, the need for further research to complement is evident.

This research will explore the use of Stroh's framework in practice through action research, and will investigate the ideal approaches to wicked problems in practice by creating system change. The aim of the research is ultimately to create a supplementary method for dealing with wicked problems based on the findings. Further, the intended result is acquire deeper insight into system change concerning wicked problems that could be catalyzed in practice using a more universal framework. Action research will be used as the learning processes are essential for taking actions not done before, such as facilitating transformational change in a system (Waddell, 2016).

1.2 Case: Spent grain handling

The case employed is the issue of brewers spent grain handling in Norway. Brewers spent grain is a by-product of beer production. Today 17,000 tonnes of spent grain is produced annually in Norway (NOFIMA, 2016), and is mostly donated to animal feed or thrown away, wasting the potential of the by-product. The case is chosen because of its smaller system limits. The system is geographically bound to Norway, and the small size of the industry. Furthermore, the lack of attention it has been given in Norway gives potential for change. The thesis is structured with the chapters: (1) Background & Theory, (2) Methodology, (3) Results & discussion, and (4) The New Framework: *System Change through Collaboration for Wicked Problems*.

1.3 Problem statement

Ultimately, the goal of the thesis is to investigate the problem statement: *“How should a framework for creating system change be in practice concerning wicked problems?”*

THEORETICAL BACKBONE

2.1 The context for system change

The earth does not need humankind (Jensen, 2006). Indeed it lived through 5 ice ages before the existence of humans (Hardy, 2003). However, the earth is on a path to rapid warming due to human-induced climate change, and the reality of not deterring global warming will affect humans worse than imaginable (Aengenheyster, Feng, van der Ploeg, and Dijkstra, 2018). Researchers underline that billions of people need to adjust their current within the next century, as parts of the earth will be inhabitable (Wallace-Wells, 2018). The poorer populations will be the most affected, and as a result may worsen wicked problems through higher inequality across society, decreased food security, and overall adverse effects on the world's economy (ibid.). Humans often react only to crises (Hardy, 2003), but if the current trajectory of societal self sabotage continues, humankind may end up with the boiling frog syndrome.

Humankind wants to maintain the current state of the environment, to continue living on the planet in its current state, therefore there has been an increased focus on sustainability . Some psychologists argue that humans are inherently egocentric (Kopnina, Washington, Taylor and J Piccolo, 2018) This explains why the view in society seems to be anthropocentric when considering environmental issues; all other beings are means to human ends (Kopnina, Washington, Taylor and J Piccolo, 2018). A perspective of why humans take action for themselves is that they act comparably like other living things on the planet: to survive. All living things seek survival through adapting to the surroundings (Plotkin, 1997). This points to the fundamental paradoxicality of human nature; an argument presented by Sigmund Freud encompassing that "the major ingredient to human nature is the will to live" (Scroggs, 1966, p. 17). However, building on the theory of organizational adaptation, his revelation is

grounded in more than the Darwinian point of survival of the fittest. In addition to avoiding death and prolonging life, Freud argues that humans ultimately pursue to maximize pleasure and minimize pain. Freud named this the pleasure principle, and he underlines that it is the key motivational factor of human nature (ibid.). Ultimately, one could argue that humans want to preserve nature for their own survival, paradoxically, humans conjointly want the most favorable life pursuing short term pleasure.

Because humans aspire what is best for themselves, humankind has set a goal under the Paris Agreement in 2015 to not increase global warming by more than 2°C (Aengenheyster, Feng, van der Ploeg, and Dijkstra, 2018). To reach the 2°C goal, within 2050 reducing global emissions by 60% or more is required (Weaver, 2007), as it is not feasible to maintain the goal without a significant reduction in global emissions (IPCC, 2019). Land sector industries, including all land uses such as forestry and agriculture is one of the sectors especially in focus. Ironically, the industry both provide humans with vital food which they are dependent on for survival, and parallel cause major emissions contributing to climate change (ibid.). In turn, climate change will affect the agricultural industry and food production considerably. Consequently scientists claim that to ensure we have enough resources major changes in human caused emissions needs to be made (Mahlman, 1997).

2.2 Sustainability in a capitalistic economy

Conventional sustainability has not yet created substantial change to reach the sustainable development goals created to tackle the environmental problems society faces today. In recent years the focus has shifted to the interconnectedness of systems, and that incremental changes are not enough. Significant change can not occur through a mechanistic and reductionist approach because then the actions taken lack the leverage needed (Gibbons, 2020). Hence the sustainability discourse should shift to a more regenerative focus, towards integrating ecology, systems theory and developmental change theory (Lenton et al., 2019). Maintaining the actions taken while also integrating a holistic approach which aims for more more significantly leveraged actions Ultimately transformational changes paradigms can occur (Gibbons, Cloutier, Coseo and Barakat, 2018).

The premise of sustainable development in the world today is that the actions towards sustainability are to be achieved within the current capitalistic economy (Wanner, 2014). An essential feature of capitalism is the motive to make a personal profit (Mahmud and Jahan, n.d.). Smith argues that this self-interest is rational and that it is the fundament of the economy today. The fundamental goal of capitalism is economic growth (Binswanger, 2009). Growth is reliant on using resources. Globally we are already consuming natural resources 44% faster than the earth can regenerate and reabsorb it (Smith, 2010). Within mainstream sustainability, economic, social and environmental resources are all valued the same, thus justifying that economic growth can coincide with becoming “sustainable” (Wilson, & Wu, 2016).

The capitalistic system is created by humankind, and its values are reflected in the economy, society, politics, and culture. Because the inherent goal for growth is integrated in all these systems, the goal for sustainable development is overshadowed. This is because sustainability concerns addressed have primarily been “solved” through individualist solutions (Mahmud and Jahan, n.d.). These solutions have focused on product development and product innovation (Melander, 2017), such as using more “sustainable” resources to reduce the impact of consumerism rather than attacking the root problem of consumption (Sachdeva, Jordan, and Mazar, 2015). However, issues that require transitioning entire systems, such as changing the inherent goal of the economy, is difficult because it is immensely complex.

2.3 The complexity of wicked problems

Wicked problems are social or cultural problems that are difficult or impossible to solve, generally because of their complex and interconnected nature (Peters, 2017). One of the first to formalize the theory of wicked problems was Horst Rittel and Melvin Weber in 1973. In the foundational article by Rittel and Webber (1973), they describe their ten claims about wicked problems (ibid.). These can be summarized as highly complex problems that are unstructured, open-ended; multidimensional, systemic and may have no known solutions. These problems may be understood as systemic dysfunctionalities within a complex system. In all cases, the problem can not be isolated and separated

2.4 System change

2.4.1 Systems

A system consists of separate units linked through a network of relationships aiming at a shared purpose (Johnson, 2021). A system is defined by Merriam-Webster as “a regularly interacting or interdependent group of items forming a unified whole.” (Merriam-Webster, 2022). More concretely, Russell L. Ackoff presents in his 1994 article *Systems Thinking and Thinking Systems* that there are three categories of systems: mechanical, organismic, and social (Ackoff, 1994). A mechanical system is presented as a unit of parts without choices and thus without purpose for its actions. The individual parts and the system, can however have a function. Conversely, an organismic system has at least one purpose, a key example being that of survival (ibid.). Even though an organismic system can have a purpose of its own, the single parts cannot. Lastly, the social system has both a purpose together, and it contains individual parts with their own purposes. Additionally, social systems are also a part of a larger system with other purposes (Gharajedaghi and Ackoff, 1984). A new system definition based on Ackoff's reasoning is presented in the article *What is a System?* (2021). The definition is as follows: “a set of systems, or parts, each with their own function, which can be open or closed to its environment, that interact to create a function unique to the system as a whole” (Johnson, 2021, p.3).

2.4.2 Systems change

System change has occurred for centuries. Humans' most abrupt system change occurred when humanity changed from being nomadic hunters and gatherers to agricultural farmers stationed at one geographical location (Gowdy, 2020). All major system changes that have influenced the current world we live in have had the basis in the pleasure principle and humans' pursuit of creating more value for themselves (Daemmrlich, 2017). For example, the Industrial Revolution, emerged as a result of the

invention of steam engines, created a significant change of the economy when moving from the production of agriculture and handcrafts to mass production of products (ibid.). Following this path, the age of science and the digital technology age are both important time periods with significant system changes led by increased efficiency and the aim for higher value creation (ibid.). Thus, these were all logical system changes that followed the path of exponential economic growth. Conversely, to create system changes for a contrary path, active system change is needed. The active interventions need to have an explicit goal, such as for the case of climate change where the focus is hindering earth to reach its planetary threshold (Davelaar, 2021).

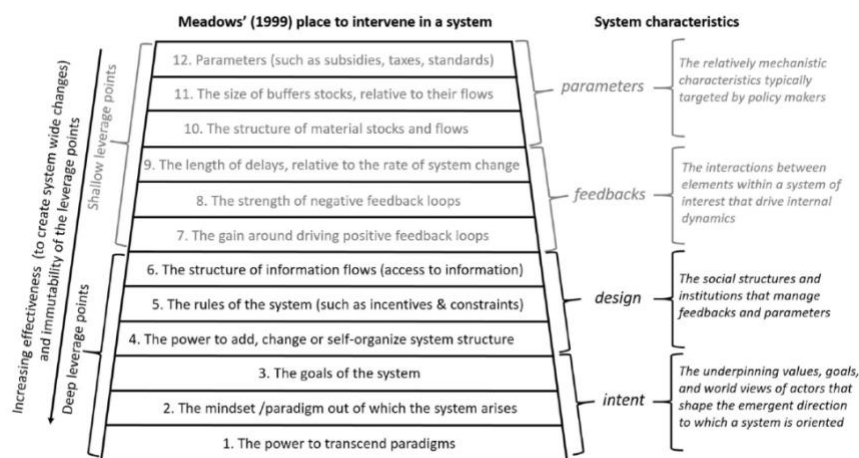
System change does not have a clear definition. However, one definition is that of Jones, Allen, Cole and Milligan (2005) in the report *Building System Change Through Public and Private Partnerships*, referring to the business perspective to system change and goes as follows: “System change is the process of getting best practices or innovative ideas accepted and then generating or redirecting the resources needed to support them for the long term” (Jones, Allen, Cole and Milligan, 2022, p. 3). Addingly, a more societal-level definition is delivered by *Catalyst 2030* - a global movement of entrepreneurs committed to achieving the UN Sustainable Development Goals (SDGs) by 2030. They define system change as: “Systems change captures the idea of addressing the causes, rather than the symptoms, of a societal issue by taking a holistic (or ‘systemic’) view” (Catalyst 2030, 2022). In other words, systemic change is development between relationships in a system with the aim of new outcomes (Johnson, 2021).

2.4.3 System change: action and outcome

System change is both actions and the outcome resulting from the actions. Some measures for system change may lead to incremental results, while others may lead to more consequential outcomes (Waddell, 2016). This is because system dynamics are interwoven and may or may not lead to ripple effects, depending on the system context (Lane, Munro and Husemann, 2016). Thus when pursuing system change both the action and the intended outcome needs to be considered.

There are many types of active interventions to create system change with different levels of leverage. Environmental economist Donella Meadows describes leverage points as “places within a complex system (a corporation, an economy, a living body, a city, an ecosystem) where a small shift in one thing can produce big changes in everything” (Meadows, 1999, p.1). The points of interaction have different leverage, and there are twelve places of intervention in a system (see Figure 2). The twelve places to intervene in a system, are arranged by order of effectiveness of change. While the shallow leverage points might be the easiest to change in a system, they are mechanical and fit best with the mindset of conventional sustainability. On the contrary, deeper leverage points are more challenging to accomplish, yet leads to more influential change.

Figure 2: Meadows’ (1999) Twelve Leverage Points (Abson et al., 2017, p. 32)



The outcome of the system change has two dimensions: “depth” and “breadth” (Desa and Koch, 2014). The depth of the system change is how radical and transformational the result is, while the breadth is the extent that people and geographical areas are involved or affected by the change (Waddell, 2016). There are different types of system changes with both different methods for intervention and aims at different results. The types of change described by Waddell (2016) are: incremental, structural, and transformational, and each focus on different leverage points and types of innovation, leading to system change in varying dimensions of system change (ibid.).

2.4.4 Incremental, structural and transformational system change

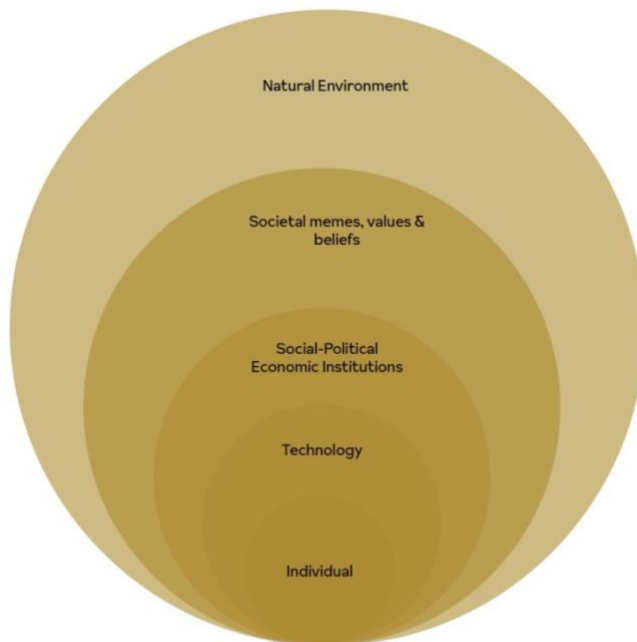
Incremental system changes focus on efficiency and improving performance in its processes (Waddell, 2016). An example of incremental effort for system change is the Walmart initiative “The Sustainability Consortium”, which seeks to advance sustainability through improving existing supply chain logistics (Waddock, Meszoely, Waddell and Dentoni, 2015). The Sustainability Consortium focuses on improving communication between stakeholders in the system, while claiming that Walmarts incremental innovation practices provide solutions for sustainability issues in the industry (ibid.). Based on this, the stakeholders can make adjustments to correct the problem, which is called single-loop learning (Tamarack Institute, n.d.). These actions are what the environmental scientist Donella Meadows describes as low-leverage interventions (Meadows 1999). While these interventions can lead to a broad outcome reaching many stakeholders, the depth of the system change is limited.

Structural system changes focus on implementing actions aimed at changing the rules of the systems, and reorganizing the systems “best practice” (Tamarack Institute, n.d.). An example of this is changing a law to reduce food waste. By identifying and understanding the causality between food wasted and the current laws and then taking action to fix the problem, double-loop learning is used to create system change (Tamarack Institute, n.d.). Referring back to Meadows, these interventions neither have the highest or the lowest leverage (Meadows 1999), meaning they are harder to implement than incremental changes. Yet, the system changes are “deeper”.

Transformational system change focuses on implementing actions aiming for radical innovation and creating previously unimagined possibilities (Waddock, Meszoely, Waddell and Dentoni, 2015). To create transformational change the eminent focus needs to be co-creating processes between. This is triple-loop learning, meaning that one must ask not only if one is doing the right things to achieve a goal, but also to decide what right is (Tamarack Institute, n.d.). An example of transformational change is the South African shift from apartheid to post-apartheid. The change was transformational, as the actions aimed at the highest leverage points (Meadows 1999). Actions aiming at transformational change may ultimately create the system change leading to paradigm shifts. To summarize, the three types of system change; incremental, structural and transformational, arise as a result of the actions implemented for the intended outcome.

According to Steve John Waddell (2016), there are different points for interference in the global systems earth (Waddell, 2016). He argues that it does not matter which point is chosen, and emphasizes that the importance is to begin somewhere (Waddell, 2016). His model (see Figure 3) divides the points into the spheres; individuals; technology; social political-economic institutions; societal memes; values and beliefs; and environmental (Waddell, 2016). Depending on the aspired outcome, the relevant entrance point vary. In fact different regions of the world often perceive one point as better. For example, in the USA the preferred focus point to create change is to begin with the individual. In contrast, the technology sphere is preferred by Germany, while other northern European countries believe the Social political- economic institution sphere is the most effective entrance point for system change (ibid.). Even though the points are divided into categories, it does not mean that the points are not interlinked, and when it comes to system change all dimensions are ultimately affecting each other (Waddell, 2016).

Figure 3: "What Changes" Model (Adapted from Waddell, 2016, p.34)



2.4.5 Businesses and system change

There are a number of powerful actors in the large global systems. Some of the actors with significant power to impose change are states, political bodies, trade unions, non-governmental organizations, and businesses (Falkner, 2008). Historically, states have had the most power and leverage to create system change, but with increased globalization and power of multinational corporations, the power dynamics have become more fluid. Ruggie (2017) points to the question on whose behalf large businesses use the authority they possess, and suggests that it must be on behalf of the businessowners - or when it comes to multinational corporations (MNC), the shareholders (Ruggie, 2017). The owners are, in the end as Smith points out (Smith, 1998), humans with the aim to serve themselves. Because businesses are powerful, get little accountability and a focus primarily on themselves, they should take more responsibility to do better in society.

Businesses have significant potential for creating substantial change in society today (Crane and Matten, 2016), and therefore also hold the potential for creating change in complicated systems. The bounds of their responsibility can be concentrated into the triple bottom line, which explains that businesses have both social, economic and environmental responsibility (Crane and Matten, 2016). However, the actual responsibility of businesses is controversial. Historically, there are different perspectives on the extent of responsibility businesses are required to take. However, the current discourse concerns whether businesses should only act in the interest of its direct stakeholder (see Figure 4), or if they should implement actions benefiting non-direct stakeholders in addition, such as the environment or society as a whole (Barić, 2017).

Figure 4: The Classic Stakeholder Model (Adapted from Borglund et al., 2017, p. 23)



In recent years, the focus in society on corporate social responsibility (CSR) has elevated in line with the increased awareness of sustainability (Fontaine, 2013). It is increasingly expected by the civil society that companies contribute to society and the environment, in addition to taking accountability of activities that might be harmful (Borglund et al., 2017). However, building further on this is “corporate citizenship”, which is the business utilizing its responsibility in society in a philanthropic manner (Crane and Matten, 2016). Resulting in business goals also being societal and environmental goals. Contrasting the current economic model in the world, when talking about corporate citizenship, increasing profit is not a goal itself, but rather financial means for realizing company activities. However, with the basis of the current economic and social systems, business would self-destruct to become fully philanthropic. Companies are powerful social actors, with the possibility to use large amounts of financial and physical resources, and should therefore use the power and resources in a responsible way in society. In the current economic system, however, there should be a way to make businesses both follow their own economic goals, while also acting in a preferred manner for the economy, society and the environment.

As the ancient adage conveys:

“With great power, comes great responsibility” (Crane and Matten, 2016, p. 50).

2.5 System thinking

When approaching wicked problems, system thinking can be a tool to grasp the bigger picture. System thinking deals with the organization of logic and integration of disciplines for understanding patterns and relations of complex problems (Department of Chemical Engineering, Lund University, 2004). The method aims to understand connections and relations between seemingly isolated things. System thinking aims at illustrating complex issues by presenting relevant questions, structuring logic, and analyzing and observing dynamics. When systems are understood, they may also be improved or solved (ibid.).

According to Danny Burns (2007) there are three waves of system thinking, and they are all significant for understanding and creating system change. The first-wave of system thinking looks at hard systems where the systems are real sets of relationships that constantly seek understanding of “what is”. First wave system thinkers see systems as “physical entities just like organisms”, which encouraged them to “seek out and identify” the world (Burns, 2007, p. 7). They thought it would be possible to develop effective interventions by modeling the “real world” interrelationships and interconnections. This form of system thinking is thus appropriate for mapping out “real”, or hard systems (Burns, 2007), such as supply chains, a logistics route, or other systems where one can generally agree on what is.

Further, the second-wave system theory builds on the first approach by involving social constructs. Churchman and Checkland (1999) argue that human systems are better understood based on meanings people ascribe to the world, and involves ideas, concepts, and values (Zexian and Xuhui, 2010). Therefore, understanding human systems include understanding the conflict between and within them (Burns, 2007). With the second-wave the emergence of soft systems as a theory occurred (Ibid). Soft-system thinking puts emphasis on the interrelationships and the multiple voices of stakeholders in those systems. Using this system thinking method, it is less important to “model” behavior and more important to understand different meanings that people create in situations, accounting for multiple perspectives (Burns, 2007). Understanding the perspective of the second-wave of system thinking to uncover possible perceived barriers and how to approach them for change. However, the second wave does not focus on the dimension of power.

Third-wave system theory focuses on power dynamics in the system as a significant variable to consider (Urdan et al., 2000). Understanding the topic of power helps identify both how it affects the outcomes of the systems and where the perceived powers shaping the outcomes are. In addition, the focus on power is essential when looking at an individual's inner power to create system change.

To create actual change, one not only needs to think on a system level; the people making the actions need to believe they can make a difference. Humans ultimately take all actions in social systems. Thus it is important to look at how humans take actions. Everyone has mental models that influence their actions. Mental models are personal, internal representations of external reality that people use to interact with the world around them (Jones et al., 2011). Individuals construct them based on their unique life experiences, perceptions, and understandings of the world. Mental models are used to reason and make decisions and can be the basis of individual behaviors (ibid). However, peoples' ability to represent the world accurately is always limited and unique to each individual. Mental models are hence incomplete representations of reality. They are also regarded as inconsistent representations because they are context-dependent and may change according to the situation in which they are used (ibid). Mental models can lead to barriers preventing actions that can improve wicked problems and create sustainability. Therefore a framework - or recipe - is needed to identify how one should go forward to make humans overcome these barriers.

2.6 Methods for system change

However, when searching for frameworks for social system transformation, there is a lack of exploration on the topic. While there are many theories and research on systems and the importance of system change to obtain better environmental and social results, frameworks to create change are lacking. There are some atomistic frameworks within system thinking and system change focusing on smaller systems and incremental changes (Teixeira-Poit et al., 2014). A more holistic framework is lacking to create a large system change transformation.

Although not a framework, *Change for the Audacious: a doer's guide* by Steve John Waddell (2016), gives an overall perspective on system change in practice with an overview of incremental, reform, and

transformational changes. He investigates in which scopes the changes occur and presents tools to do so. He focuses on the importance of participatory processes when using the tools (Waddell, 2016). Waddell presents different angles one can try to achieve system change from, but he does not present a framework, making it challenging for those unfamiliar with system change to understand where to start when "attacking" the problem they want to improve.

2.7 Research on methods for system change

Researching system thinking is challenging because it has many dimensions. But researcher methods for tackling more complicated system changes point to out that there is not enough scientific research on methods for creating real systematic change. Such Foster-Fishman, Nowell and Yang paper *Putting the system back into systems change: a framework for understanding and changing organizational and community systems* (2007) points out that research lacks the practical application of theory - actually creating change. They state that “there is a dearth of frameworks that scholars, practitioners, and funders can draw upon to aid them in understanding, designing, and assessing this process from a systemic perspective” (Foster-Fishman, Nowell and Yang, 2007, p. 1). There is a considerable amount of research on system change and there are some frameworks for system change in practice. However, the holistic approach is often not a focus in frameworks because of system complexity. In addition, the process of testing methods for large system changes in practice and collecting research is very comprehensive due to the time and resources needed to create change. This points to the research gap on frameworks applied in practice with the holistic approach.

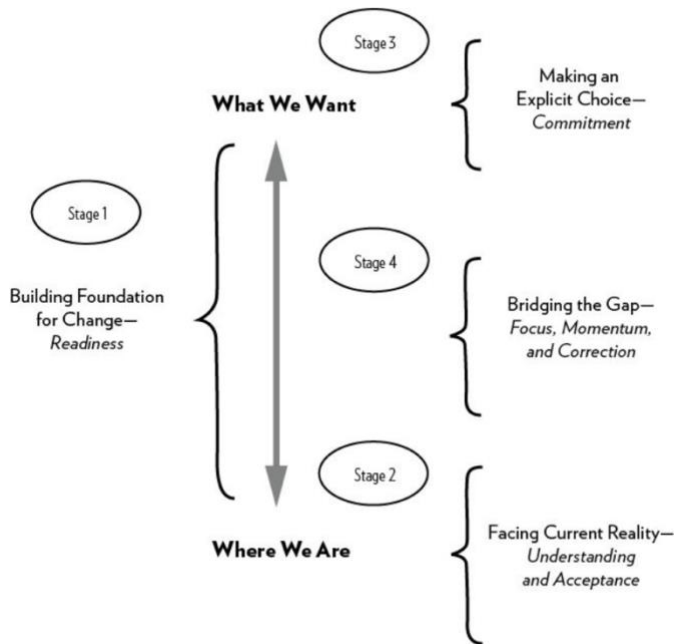
2.8 The framework: Systems Thinking for Social Change

The framework by *David Peter Stroh* called *Systems thinking for social change* attends to solving complicated problems through system thinking in practice. The framework addresses how to go from conventional linear thinking to addressing chronic, complex social issues. It has the premise that “Applying systems thinking principles and tools enables you to achieve better results with fewer resources in more lasting

ways” (Stroh, 2015). It does so through this four-stage change management process: (1) *Building a foundation for change*, (2) *Facing current reality*, (3) *Making an explicit choice*, (4) *Bridging the gap* (see Figure 5).

The process begins with building the foundation for change by engaging key stakeholders, establishing the common ground, and developing the stakeholder's ability to collaborate. The second stage aims to build a shared understanding of the current situation through system mapping and how the actors involved are responsible for this current reality. The third step revolves around making the stakeholders see what they must do to achieve their goals, aware of the necessary costs and compromises, and making an explicit change choice. In the final stage, the stakeholders must bridge the gap, removing the discrepancy between their ambitions and the current situation.

Figure 5: Four Stages of Leading System Change (Stroh, 2015, p.90)



Stroh's framework has been applied and solved system issues many times. The book about the framework has been a bestseller on Amazon, thus being influential not only in academia but for those actively applying system change. It has currently been cited almost 500 times on google scholar, yet

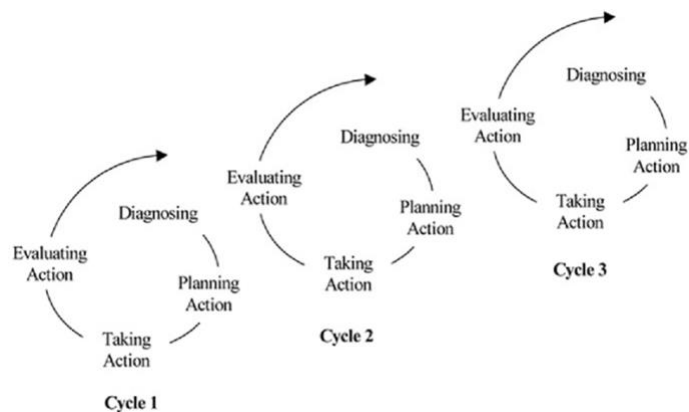
the researchers have not found any attempt to test how the framework unfolds through action research.

2.9 Action-Based Research

According to Flood, it is with action research one learn and may act meaningfully within the unknowable, and the unknowable can be approached through systemic thinking (Flood 1999 in Burns, 2007). Wanting to create systemic changes for sustainability should therefore be approached with a framework for system thinking - such as that of Stroh - and research on this should be done through action research. According to Burns (2007) there are two ways to investigate system change. The first is that of large systems which includes ethnographic observations. The second is networked system inquiry. The latter includes working alongside the system, gathering both qualitative and quantitative data. The larger the system change aimed for, the longer time is needed to create results. Then, for smaller networked systemic changes, one will (hopefully) see smaller results faster. Supported by Meadows, smaller interventions may create a shift that can produce ripple effects leading to big changes over time (Meadows, 1999).

Within action-based research on system thinking and system change, one must generate questions such as “If we did this, what do we think would happen”, then observe and refine the theory of change (Burns, 2013). To do so, one must narrow down the scope one wants to investigate because - as stated previously - all systems are interconnected, and changes in one place will affect the other. Bradbury-Huang (2010) explains action based research as a destination to knowledge creation that arises in a context of practice working *with* practitioners, rather than to study them (Bradbury-Huang, 2010). The method for action research is cyclical and includes four steps that are repeated until the desired result is acquired (see Figure). The four steps of action-based research include: (1) Diagnose/ investigate, (2) Plan, (3) Act, and (4) Evaluate/reflect (Sekaran and Bougie, 2020).

Figure 6: Spiral of Action-research Cycles (Adapted from McPberson, 2002, p.443).



Very briefly, the action research method is to identify a problem area and then collect data on the issue. Bradbury-Huang (2010) explains the difference in purpose between conventional research methods and action research. The difference is that action research aims to understand situations and create change by impacting stakeholders or creating knowledge, while conventional simply understanding through creating knowledge (Bradbury-Huang, 2010). The article also presents several “criteria” or “choice points” for good action research based on different authors' previous literature (see Table 1). The seven points for good action research are: (1) articulation of objectives, (2) partnership and participation, (3) contribution, (4) methods and process, (5) actionability, (6), reflexivity, and (7) significance (ibid.).

Table 1: Seven Choice Points for Good Action-research (Bradbury-Huang, 2010)

<p>Articulation of objectives: “The extent to which authors explicitly address the objectives they believe relevant to their work and the choices they have made in meeting those”.</p> <p>Partnership and participation: “The extent to and means by which the project reflects or enacts participative values and concern for the relational component of research. By the extent of participation we are referring to a continuum from consultation with stakeholders to stakeholders as full co-researchers.”</p> <p>Contribution to action research theory: “The extent to which the project builds on (creates explicit links with) or contributes to a wider body of practice knowledge and or theory, that contributes to the action research literature”</p> <p>Methods and process: “The extent to which the action research methods and process are articulated and clarified.”</p> <p>Actionability: “The extent to which the project provides new ideas that guide action in response to need.”</p> <p>Reflexivity: “The extent to which the authors explicitly locate themselves as change agents”</p>
--

Significance: “The extent to which the insights in the manuscript are significant in content and process. By significant we mean having meaning and relevance beyond their immediate context in support of the flourishing of persons, communities, and the wider ecology.”

Chapter 3

METHODOLOGY

The methodology for the thesis is an exploratory action-based qualitative study. The research focuses on the case of the system surrounding the handling of spent grain tested with the framework *Systems thinking for Social Change*, with an experiential, participatory approach. (Bell, Bryman and Harley, 2019).

Action-based research is a practical methodological approach that focuses on problem-solving (Sekaran and Bougie, 2020). Existing research on system change is not practical, and thus specific methods are lacking. The research methods is often used in the business context to attempt to change rigid behavior and develop data with a high level of relevance (Yu, 2021). Thus it can help provide in-depth knowledge on one specific issue (Sekaran and Bougie, 2020) such as the one of improving wicked problems through system change. In the book *Systems thinking for Social Change*, Stroh (2015) emphasizes that the framework is designed for better system thinking and challenges conventional thinking as a tool for problem-solving (Stroh, 2015). For that reason, action research is chosen as the method for applying David Peter Stroh's framework, *Systems thinking for social change* in practice.

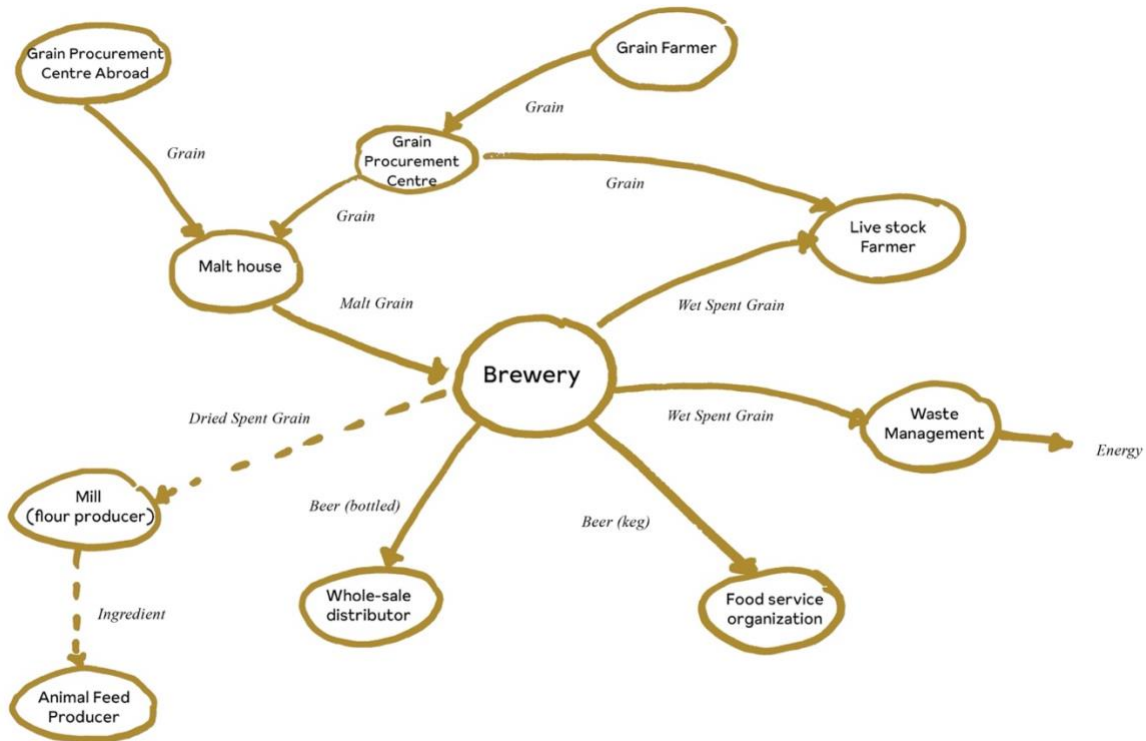
Hence the method provided the possibility of exploring improving processes for dealing with wicked problems. The following chapters elaborate on the choices made for the methodological approach of the research: (1) research case, (2) sample selection, (3) research design, (4) data collection and analysis, (5) validity and reliability, and (6) and ethnographic personalities.

3.1 Research case

The case for this research uses the framework *System Thinking for Social Change* to practice in practice to undertake the issue of brewers spent grain handling. Brewers spent grain is the by-product from beer production, and case is chosen because it has higher potential for utilization than the current disposal. In addition, the system surrounding the issue of spent grain handling has relatively small system limits (See Figure 7), which was feasible to change within the research timeframe. The system in focus is geographically bound to Norway, and the small size of the brewing industry. Furthermore, the chosen case has the potential to deliver physical results, both in terms of actual system change, and academic results.

The issue of spent grain handling is part of a larger wicked problem concerning topics such as climate change, the use of scarce natural resources, global land-sector emission, and the need for circularity. Additionally, a factor worth considering in the current state of the world is the changes in global supply chains in grain and oil due to the Russian invasion of Ukraine (Mbah and Wasum, 2022). The personal motivation of the researcher for choosing this topic is the wish to contribute to the possibility to create systematic changes needed to solve major challenges society faces today. The want for change should come from within when doing action-based research (Nordby, 2016). The researchers will have the role both as an initiating actor and as researchers.

Figure 7: Overview Map - The Spent Grain System in Norway



3.2 Research design

According to Bell, Bryman and Harley (2019), action-based research is the best way to improve programs or practices (Bell, Bryman and Harley, 2019). As there are lacking methods on how to create system change actively, The goal of the thesis is to investigate the problem statement: *“How should a framework for creating system change be in practice concerning wicked problems?”*.

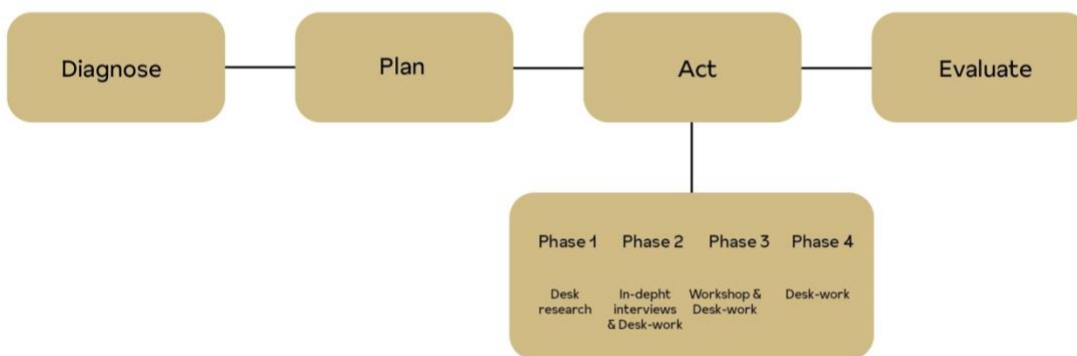
The problem statement is answered through the following two research-questions:

Research question 1: *“What are the reflections based on the methods used based on Stroh’s framework in practice?”*

Research question 2: *“How could the framework be adjusted to work with wicked problems in practice?”*

The research design of this thesis is developed based on the four classic steps of action research (see Figure 8). The steps include: (1) Diagnose/ investigate, (2) Plan, (3) Act, and (4) Evaluate/reflect (Sekaran and Bougie, 2020). Due to the short timeframe of this thesis, the research design plan for only one large cycle. However, smaller cycles occurred within the steps as action-based provides for this "learning as you go"(Stacey, 2007, p.7). The structure for "act" study is based on Stroh's theoretical framework, *System thinking for Social Change*. There are four steps presented, which the researchers will use as an outline when collecting data. The four steps are: (1) Building a foundation for change, (2) facing current reality, (3) making an explicit choice, and (4) bridging the gap (Stroh, 2015).

Figure 8: Research Design



3.3 Sample selection

Action-based research is the study with humans - not on humans (Reason and Heron, 2022). Participants were chosen based on the system actor identified in the current system for spent grain handling in the area of eastern Norway, with the existent possibility to collaborate for system change (see Table 9, Appendix A.iii). The sample was broad in terms of industries and specialized subject areas, to have a wider range of possible paths for collaboration. Three types of actors were included in the research. Firstly, actors that are directly influenced by the issue of spent grain handling. Secondly, actors that are part of the system surrounding spent grain handling. Thirdly, the actors the researchers

thought had the potential to be part of a future system for spent grain handling. The only three key stakeholders identified as being actively part of the current process of spent grain handling were the brewery, the animal farmer, and the waste management service.

The methods for acquiring participants include listing ideal participants from companies representing the actors in the system (see Table 2). Then participants is contacted, starting with CEOs, founders, or sustainability responsible. The contact was through LinkedIn or e-mail including a “consent form” (see appendix C), or in some cases, through the researcher's network. The snowball method was used to some extent, as new actors were discovered throughout the interview process (Snijders, 1992). The interaction with the participants includes one personal interview with the 18 chosen interview subjects and three meetings with the three chosen actors including their representatives: a kick-off meeting and two milestone meetings.

Table 2: Study Participants for System Actors

Participants Representing Actors in the Spent Grain System	
Position at Company	Company
Brewery	
Brewmaster	Sagene Bryggeri AS
Chief of development	Ringnes AS
Brewmaster	Macks Ølbryggeri AS
CEO and founder	Beer Flag AS
CFO	Arendals Bryggeri AS
Assistant CEO	Svalbard Bryggeri AS
Animal Farmer	
Farmer	Ner-Bartnes gård
Grain Procurement Centre	
Animal Feed Producer	

CEO	Felleskjøpet Fôrutvikling AS
Grain Farmer	
Malting house	
CEO and founder	Bonsak AS
Waste management Service	
Wholesale distributor	
Retailer (e.g. grocery store)	
Food service operations (e.g. restaurant or bakery)	
End user	
Start-up making human food of spent grain	
CEO and founder	Attåtnering AS
Researcher (economist)	
Researcher and economist	Danmarks Tekniske Universitet and NIFU
Researcher (nutritionist)	
Researcher and Professor of chemistry, biotechnology and food science	Norwegian University of Life Sciences (NMBU)
Public entity that fund innovation	
Special adviser for bioeconomics	The Research Council of Norway
Special adviser and subject manager for bioeconomics	Innovation Norway
Director of Analysis and Policy	Norkorn - NHO Food and Drinks (FoodDrink Norway)
Drying company	
CEO and founder	Waister AS
Mill	
CEO	Cemova Industri AS
Food producer	
Specialist in Raw milk	Tine SA

3.4 Data collection and analysis

Data collection and analysis was conducted simultaneously throughout the research period (January 2022-May 2022). This fluid method for data collection and analysis is customary for action-research (Bell, Bryman, and Harley, 2019). Stroh's framework provides tools and methods to create system change, and are the basis for the measures taken in this research (see chapter 4.1. Overview process of applying framework to practice). This chapter explains the data collection methods in relation to research purposes. This chapter will weigh the different data collection methods and their purpose, followed by an explanation of the data analysis method.

Data collection

Firstly, desk research is used to gather data for the theoretical backbone and to understand the industry and the system through secondary sources. These sources consisted of relevant academic journal articles, books, reports and other scholarly sources. The aim was to gain insight into the process of system change, related topics, and the industries that the researchers approached before approaching participants. To understand the current state of the system, the researchers read more recent sources such as news articles and industry reports. In addition, the researchers obtained background information about the actors and study participants through media such as company web pages and LinkedIn. While these data sources give a broad picture of the systems and the companies, essential information on how to work with the systems surrounding the case does not exist as secondary sources; This information must be obtained through observation and action (Krueger and Casey, 2022).

Raw data was obtained through the 18 in-depth interviews conducted with the study participants representing the system actors. Throughout the interviews, notes were taken and afterwards reflections were written down in a learnings journal creating interpretive data (Evans, 2002). The purpose of interviews was to gain insights from those specific actors and get a clearer picture of their potential for collaborations. The interviews were conducted as a video conference call through the cloud-based video

conferencing service Zoom, as there were still covid-19 restrictions during the interview process. Weaknesses from conducted interviews digitally were minor disturbance of the communication, such as lack of body language understanding, and/or poor sound quality. In addition, the study participants may have answered more controlled and short than in a physical setting. Additionally, communication through email and over the phone occurred in tandem with the interviews, these were not formal or structured interviews, but rather information was gained .

Data generation in this research project occurred mainly through the researchers' reflections. With action research, the researcher does not seek absolute truths (Nordby, 2016), but the aim is rather to create an overview of “one perspective of the system” (Mohan, 2020). The reflections were based on initial thoughts, understanding of the system and the actors, the usefulness and purpose of methods and tools from the process, and result from intervening in the system through actor-interviews and meetings. To minimize time bias the reflections were written down immediately (Gleiss, Oberbauer and Heinze, 2017). The interpretive data written down in the learning journal helped the researcher remember the initial reflections correctly, so that when going back later in the process a deeper understanding formed (Coghlan and Brydon-Miller, 2014). This journal was separate from the interview- and meeting notes, to not distort what the study participants said and the interpretation of what they meant (Reason and Heron, 2022). The learning journals were structured by each step of the framework, but also included more general reflections on the process as a whole.

The interpretive data was developed further through systematic mapping (James, Randall and Haddaway, 2016); using tools, tables and models from the framework. The researchers refer to this procedure as “desk work” in the rest of the research paper. Additionally, the tools were re-done multiple times to improve the insights and thus reflections on how one can use and improve frameworks, showing the loops of action-based research (Sekaran and Bougie, 2020). The roles of facilitators and researchers fluctuate (Kennedy-Lewis, 2012). Therefore, the researchers do not get insight into being only a facilitator. If the researchers had tried just to facilitate, the researchers would not have used the additional time to try to improve. Thus the result for the framework would neither be as good, limiting the strength of the research.

The core interference or “action” of this research consisted of connecting actors together to facilitate actual collaboration aiming to lead to system change. After interviewing study participants representing the system actors Arendal Bryggeri (brewery) and Cernova Industri (flour producer), and seeing the potential for higher value creation of spent grain, they were connected. Few days after giving Cernova the contact information of Arendal, they had their first phone call, and later Felleskjøpet Fôrutvikling (animal feed producer) joined the collaboration. Further, the role of the researchers when facilitating the first meeting between the three the actors functioned as “participant as observations”, as the researchers were actively participating with their identities revealed (Whitehead and Lopez, 2013). Facilitating the kick-off meeting as a method led to insight of the mental models of the actors and the barriers and opportunities for a potential collaboration between them. In addition, reflection on the use of tools and methods from Stroh’s framework was obtained after presenting system theory such as system maps. In contrast to the kick-off meeting, changed the role of the researchers to “observer as participant” in the two milestone meetings as the active participation was less prevalent (Kennedy-Lewis, 2012). However, action-research promotes iteration (Baskerville and Wood-Harper, 1996), so the data collected from observations contributed to understanding the development of the project. These meetings were also conducted digitally like the interviews through Zoom, thus prevailing similar limitations of the method. Ultimately, the matching by the researcher of a real possible collaboration for system change validates the purpose of the Strohs framework.

Supplementary data was obtained through mentor meetings with David Peter Stroh and Simen Knudsen. Simen Knudsen from Æra Strategic Innovation used his knowledge and experience of creating actual system change, to aid the understanding of solving wicked problems. While, David Peter Stroh, the author of the framework, assisted in the understanding of the use of the methods and tools throughout the process, deepening the knowledge of the process for the researchers (Anagnou and Fragoulis, 2014). The purpose for involving mentors in the research project was that the researchers saw it beneficial to involve experienced practitioners as inexperienced in the method of action-based research. The mentor meeting occurred monthly with each mentor through Zoom for the entirety of the research period. Data obtained provided insightful assistance for the process as well as deepening the understanding of practical system thinking. However, a limitation to this data is the fact that the mentors did not observe the interactions with participants or obtain background

information in the specific case, causing the feedback to be based entirely on the reiteration of the researchers interpretations.

Data analysis

The data collected in the process was analyzed continuously, as a cyclical process (see Figure 6). The analysis was open, as the researchers focused on seeing patterns and themes that occurred throughout the research process. Themes occurred organically throughout the process, and became basis for key reflections. Variables such as the study participants position in the company, the size of company, or how convincing the study participant sounded, were considered when interpreting the data as “truths. The importance of the themes was based on whether the topic occurred repeatedly, both in relation to the same study participant and to multiple study participants. Some of the initial themes were barriers to change such as “power dynamics”. Yet, others were driving forces such as “innovative solutions” to spent grain handling existing in the system. In addition to the structural reflections per chapter of the framework, additional themes occurred continuously and as the understanding of the researchers deepened the depth reflection mirrored. This process was done by the two researchers simultaneously, discussing themes to broaden the understanding for both and creating more holistic results. Throughout the duration of the research process, the problem statement was considered, and all the themes and following discussions aimed to answer how a method could be used in practice to initiate system change. The concrete solution to answer the question of what the best method for system change is, resulted in the formation of a new framework.

3.5 Validity and Reliability

Although action research is a suitable method for understanding and changing issues in practice (Porter, 2007), there are limitations to using action-based research. The method gives freedom, both for method and interpretation; however, validity and reliability relies on the researchers (Melrose, 2001). Action researchers both have a choice about the method(s) they use to collect, analyze, and

interpret data; and have a choice about their interpretation of rigor to suit the topic or field of practice (ibid.). This restricts the generalizability of the results (Baskerville and Wood-Harper, 1996).

The construct validity of this research is high as the correct operational measures are employed to achieve the research goal (Bell, Bryman, and Harley, 2019). Similarly, the internal validity of the study is high as the reflections are principally the data of consideration, and the research questions aim to create reflections on methods used (ibid.). On the other hand, the external validity of the research is low, as the finding cannot be generalized across social settings (Baskerville and Wood-Harper, 1996). The validity of the research in addition affected by the zeitgeist of the world today, – especially with the Covid-19 pandemic and unrest in the world due to the Russian Ukrainian invasion (Mbah and Wasum, 2022). It is also important to mention that from a scientific perspective, action-based research has limited significance due to the objectivity and low replicability of results, as well as the dependency of external participants (Sekaran and Bougie, 2020).

3.6 Ethnographic personalities

The ethnographic personalities of the researchers is presented in this section to increase the validity of the research (Bell, Bryman and Harley, 2019). The ethnographic personalities include context such as the background, roles or motivations of the researchers that might have an impact on choices and interpretations in the research. An significant aspect of action-based research is the researchers' interpretation and personal biases (Melrose, 2001). Therefore an autobiographical note of the two researcher of this thesis (Eva Helene Nagelhus and Fam Leborg) is offered to help contextualize claims, create transparency, and anchor ownership of expression that can otherwise masquerade as worryingly disembodied and neutral (Bradbury-Huang, 2010).

3.6.1 The researchers - Background, biases and reflexivity

Both Eva and Fam are enrolled in the Master's degree program of Entrepreneurship and Innovation at the Norwegian University of Life Sciences (NMBU). Because of this, both possess the background knowledge and experiences related to innovation- and entrepreneurial fields.

Fam has a bachelor's degree of International Fashion Management from Amsterdam Fashion Institute Amsterdam University of Applied Sciences with a minor of Business Administration: Strategy and Marketing from The University of Amsterdam, and a minor of International relations from Dowling College, New York. It is also relevant to mention that Fam has an International Baccalaureate (IB) high school degree from the American Embassy School, in New Delhi, India where she lived for three years. She has experience with innovation and system change, especially in the fashion industry through previous projects and her own start-up. Her view of the world might have been affected by growing up as a third culture kid, moving to Asia already as a ten year old, and living in six different countries around the world.

Eva has two bachelor's degrees, one in International Environment and Development Studies and one in Economy and Administration from the Norwegian University of Life Sciences (NMBU). She has a particular interest in environmental sustainability and circular economy. The interest for the global context evolved when studying in Nicaragua, Guatemala, Vietnam and England. When it comes to system change within the food system, she has previously worked with this through her startup, activism, debates, and as a politician. She has previously worked with spent grain in two university courses, and thus brought both background information and biases about the industry to the research.

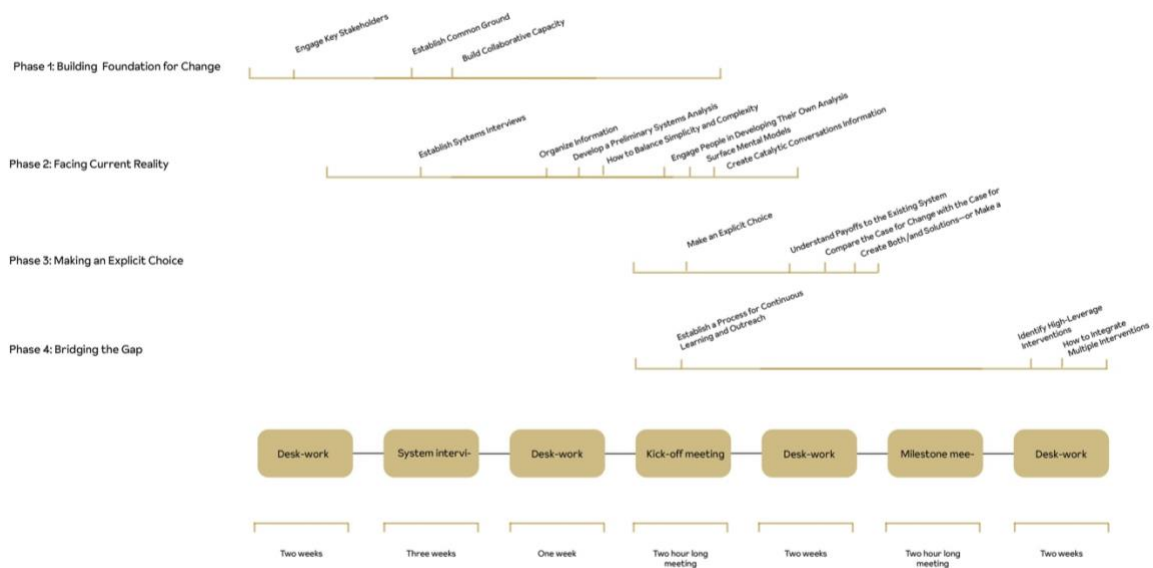
Both researchers practiced system change through the leadership program Future Leaders. The program aims at teaching self development, as well as communication and collaboration methods to navigate the world and create actual system change. Having this experience shapes the interpretation and understanding of both the framework methods but also system theory. Fam and Eva have different backgrounds, and thus also different approaches to system thinking. While Fam easily sees broader business perspectives, Eva has a tendency to look at how people's personalities and knowledge affect their actions. However, this can be seen as an advantage, as varying perspectives incorporated will create a more holistic impression.

FINDINGS AND DISCUSSION

2.1 Overview research process

The research project is divided into seven parts: (1) preliminary desk-work, (2) system-interviews, (3) desk-work after interviews, (4) kick-off meeting, (5) desk-work after kick-off meeting, (6) milestone meetings, (7) final desk-work. Certain of Stroh's sub-steps were done in one bulk. The overview (see Figure 9) illustrates the time used on each part, to understand the timeframe of the whole research project. All the steps were executed where found most appropriate, considering the short amount of time conducting the framework in practice. The parts of the process are presented by sections in this chapter.

Figure 9: Overview – Research Process



Preliminary Desk work

In this part, the step from Stroh's framework *Engage Key Stakeholders* (Stage 1: Building foundation for change) was implemented.

Stage one started by conducting in-depth research of the chosen system of brewers spent grain handling. This included identifying current stakeholders, processes and possible alternate solutions for spent grain. Furthermore, an overview of the system was created, to understand the purpose of the actors, processes, and product flows (see Figure 7). Based on this overview, a list of companies representing the actors and contact information of relevant employees was made beginning with CEO's and most relevant employee (see Table 2). After identifying actors the table "*exposed purpose vs hidden priorities*" was filled in (see Table 5, Appendix A.iii) to map the possible motivation to creating change for each actor, based on estimated guesses. In addition, the table "-3 -+3" (see Table 4, Appendix A.ii) was filled in to estimate the level of motivation of the participating actors.

System- interviews

In this section, the steps from Stroh's framework *Establish common ground* and *build people's capabilities to collaborate* (Stage 1: Building foundation for change) was implemented. In addition, the step *Establish System Interviews* was executed here (Stage 2: Facing Current Reality: Building support by system mapping).

The step *Establish System Interviews* was merged with two other steps of the framework, in order to effectivize the data gathering within the time frame. The step began by creating a semi structured-interview guide (see Appendix B). The first step included was *Establish common ground* with the purpose to make the actors "map their current reality" and "envision a future scenario" to create a shared vision. The second step from the framework merged into the interview guide was *Building people's capabilities to collaborate*. This aimed at assisting the interviewees develop three skills, one of them being to "think systemically". Thus, the interviews included three themes with accompanying questions: (1) map the current reality of the system, (2) explain their ideal system, and (3) think on a system level. In

addition, questions about the system structure were added for us as facilitators and researchers to acquire a better understanding of the system.

In total, 18 one-on-one interviews were conducted. Throughout, notes were taken for all interviews, then analyzed afterwards. Apparent mental models of the actors were immediately taken note of, and later applied in the table “*mental models of key actors*” (see Table 11, Appendix A.vi). Reflecting upon and analyzing the findings from each interview is a time consuming part of this research process, but a necessary activity within the framework. Using the interview guide as a starting point, questions were adapted to each individual study participant. In addition, key ideas from the framework such as “advocate own view”, and “introducing skills and tools from the book” was used in the interview, in order for the interviewees to better understand system thinking. The purpose was to make the participants understand that their personal experiences and unique industry insight was crucial to gain an overview of the system as a whole. After interviewing Cernova Industri (flour producer), and Arendal Bryggeri (brewery), the opportunity for a collaboration prevailed. In order to reach economies of scale, the participating main actors viewed the Norwegian agricultural cooperative Felleskjøpet Fôrutvikling (Animal feed producer) as a relevant collaborator, and invited them to join the discussions (CEO of Cernova Industri, 2022). Felleskjøpet was approached for an interview by the researchers before the meeting, however they were unable to be reached.

Desk Work after interviews

In this section, the steps from Stroh's framework *Organize information, develop a preliminary system analysis*, and *How to balance Simplicity and Complexity* (Stage 2: Facing Current Reality: Building support by system mapping) were applied.

The data obtained from the system interviews was organized (*Organize information*), and archetypes were searched from the storylines. Consequently, system maps were created (see Figure 11,12 & 13, Appendix A.v). based on the observed archetypes (*Develop a preliminary system analysis*). The collaboration between Cernova, Arendal Bryggeri and Felleskjøpet provided a solution to the issue of spent grain handling, through creating a new supply chain where the spent grain would increase its value by

becoming animal feed through a drying and milling process. As the focus narrowed towards the three specific actors and their common goal, it made system mapping less complicated. The goal of the collaboration was to dry spent grain to both be used as food for human consumption and animal feed. When creating system maps for the three actors, only Arendal was experiencing the issue of “spent grain handling”. The two other actors' issues had to be further explored (CFO of Arendals Bryggeri, 2022). When system mapping the starting point was the archetype “shifting the burden”, and loops were later added to make it more holistic, avoiding making it overly complicated (*How to balance Simplicity and Complexity*). The reasoning for creating three separate system maps was in order to illustrate that the three industries all work with shifting the burden separately with different problems, illustrating that the issues could improve if the three companies collaborated in an interconnected system.

Kick-off meeting

In this section, the steps from Stroh's framework *Engage people in developing their own analysis, Surface mental models* and *Create Catalytic Conversations* (Stage 2: Facing Current Reality: Building support by bringing the system to life) were implemented.

The kick-off meeting with an aim to reach collaboration between Cernova, Arendal and Felleskjøpet, was conducted to discuss their potential future system. The meeting was facilitated by the researchers as a result of identifying the potential to match Cernova with Arendal, and bringing the company's decision makers in contact. The facilitation intended to clarify all parties' expectations, and furthermore with the goal of the actors to reflect and share their motivation for partaking in the project. This included a clarification on the potential gains of collaboration, where their focus was to reach their intended goals, and what the possible learnings may be acquired from the project (*Create Catalytic Conversations*). Cernova, Felleskjøpet and Arendal had their separate initial intentions for taking part in the project, and it was therefore important for “us as the researchers” to facilitate a clarification of intentions and expectations (Pilot-project group: Cernova, Arendal and Felleskjøpet, 2022).

In the kick-off meeting the researcher presented alternative system maps with relevant theories (Pilot-project group: Cernova, Arendal and Felleskjøpet, 2022). The researchers explained the three separate system maps, portraying how the three key actors were shifting the burden away from themselves, adding loops to the archetypes, and unveiling how collaboration could lead to positive outcomes for all involved parties (*Engage people in developing their own analysis and Surface mental models*). The flour producer and the animal feed producer had followed the “accidental adversaries”. The feed producer had initially been against the upcycling of spent grain for animal feed, as farmers already used it for free. Subsequently, an alternative solution, where the process of drying the spent grain was introduced, this solution benefits all three actors, as the value of the resource increases when the product is preserved.

Desk-work after kick-off meeting

In this part, the steps from Strohs framework *Understand Payoffs in the existing system*, *Compare the case of change with the case of status quo*, and *Create Both/ And Solutions or make Trade-offs* (Stage 3: Making an Explicit Choice) were implemented.

These stages were conducted by the researchers of this project, without the involvement of the three key actors. This was done as a result of the limited time frame of the project, however after obtaining plentiful information from the interviews and kick-off meeting, the researchers conducted the following analysis of the three core actors, as described in Stroh’s framework. Firstly, the table “*Understand payoffs in existing system*” was per actor (see Table 12, Appendix A.vii), to understand the benefits, their cons and pros for changing. Considering the possibility that the current system might be superior to the alternative system. Furthermore, the table “*Compare the case of change with the case of status quo*” was created per actor (see Table 13, Appendix A.viii), in order to compare the cost to the benefits of changing to a new system. Lastly, the table “*polarity models*” was applied (see Table 14, Appendix A.ix), to identify if they can have an “both/and” solution, or “either/or”. The tables shows that Arendal must choose an either/or solution; either donating the spent grain or investing in technology needed to preserve/burn the spent grain. Said differently; They either need to go “all in” and invest, or continue business as usual. Cernova and Felleskjøpet on the other hand, have the

possibility to create “both/and” solutions, meaning that they can sell spent grain as a product, while continuing the rest of their business as usual.

Milestone Meetings

In this section, the steps from Stroh's framework *Make an explicit Choice*, and *What can you do when people are still not aligned?* (Stage 3: Making an Explicit Choice) were implemented, in addition to the step *Establish a process for continuous learning and outreach* (Stage 4: Bridging the Gap).

The milestone meetings were conducted as follow-up meetings from the kick-off meeting between core actors. This meeting was observed by the researchers, which had no active role in these meetings besides a facilitation role. The researchers were less interactive in comparison to in the kick-off meeting, however it proved useful to gather empiric evidence of the process. During these meetings, the three actors divided action points between them, and identified which points needed further investigation until the next meeting. The researchers were also invited to their Teams channel and included in their e-mail threads, which provided transparency and allowed the researchers to gain overview of all communication conducted. Regarding solving a wicked problem, the discussions alternated around which options were optimal financially: both utilizing brewers spent grain for burning, or animal and human food. (Pilot-project group: Cernova, Arendal and Felleskjøpet, 2022).

Final desk-work

In this section of the research, the steps from Stroh's framework were *Identify High Leverage Interventions* and *How to integrate multiple interventions* (Stage 4: Bridging the Gap). Due to limited scope of the research project- the researchers did not complete all aspects of this step. A table was created with leverage points for the project, (see Table 17, Appendix A.x), and the three actors are currently (May 2022) continuing to investigate the possibilities of funding for the pilot project.

2.2 Key reflections research process

This chapter presents key arguments based on reflection on the process of applying the framework *Systems thinking for Social Change* in practice. The chapters are divided into the four stages of the framework: (1) Building a Foundation for Change, (2) Facing Current Reality, (3) Making an Explicit Choice, and (4) Bridging the Gap.

2.3 Stage one: Building foundation for change

The purpose of stage one, according to the framework, is to “build a foundation for change” (Stroh, 2015), and the intended result is to “develop collective readiness for change”. The key findings from applying the stage are presented in this chapter as the following arguments: (1) The need to be aware of assumptions of a framework, (2) The need for an initiator to commence a process aiming for system change, (3) The need to narrow down the wicked problem before identifying and engaging actors, (4) The need for an initial system overview, (5) Different individual goals can lead to one shared future, (6) The need to identify actors type of motivation, (7) The need to rank the actors' motivation, and lastly, (8) The planning of actor-interviews is twofold: choose actor representatives and determine the order of actor-interviews (Ibid.).

When using a framework with the purpose of solving wicked problems, one needs to be aware of the assumptions or criteria the framework has. Not being entirely aware of the assumptions of Stroh's framework before applying it, valuable time was wasted on executing steps inaccurately and reorganizing. When following Stroh's framework, observation proved that additional criteria are required for the framework to be successful. In Stroh's book (2015), purposes and specific tools were explained, however, the prerequisite conditions were not (Stroh, 2015). Three prerequisite conditions of Stroh's framework were discovered through the research as they appeared as a hindrance in the process. Firstly, a group of actors willing to work together on an issue was a prerequisite for collaboration. Secondly, a host is needed in order to narrow down the scope, and thirdly a facilitator with knowledge of system theory will allow the process to follow the framework to achieve the goal of system change. These learnings provided the researchers with an understanding of the specifications

and required prerequisites, this allowed the researcher as the initiator to create the conditions needed for the theoretical framework to be correctly applied and for the project to be conducted successfully.

An initiator's purpose is to bring actors together in order for the process of system change when no one has come together already. Spent grain had until this project was initiated been a waste product to the breweries and handling had been a concern to them. Therefore, through the initiation provided by the research project and the successful outcome of the expected change in the system, the importance of an initiator has prevailed. This project culminated in collaboration between the three key actors, which additionally illustrates that the initiator for change does neither need to be an actor causing the issue, nor an actor affected by the issue when dealing with complex problems. Furthermore, the initiator is not required to be the actor that provides the solution. For example, results showed that Cernova, the flour producer, was interested in creating change for spent grain handling and engaged them to create change. Thus, this shows that when initiating system change, the importance is not necessarily who does it, but ultimately for the process to commence.

The research showed that actors can only be identified and engaged after the scope of the issue is specified when approaching wicked problems. The initiator's role is to narrow down the scope from a general wicked problem to a specific issue that can be resolved through a process such as going from a range of possible alternate uses of spent grain to the purpose of human consumption. This is done based on variables such as: the actors, resources, and given timeframe. In a mentor meeting with Stroh, he specified that typically he is approached by a group of actors that have come together to solve an issue, then he would go through the framework's steps; Thus eliminating the need to do this step. The industry and actors were identified at the beginning of the project to acquire an overview. Reflections from the research emphasize that starting broad and narrowing down the scope of the issue made it possible to preliminarily weigh different options, followed by concretizing variables that can be configured into possible solutions. In the research case, the issue of spent grain handling was narrowed down to focusing on solutions concerning human consumption. This created a path forward, with the possibility to gather actors motivated to follow the identified path. Therefore, before engaging actors, mapping out relevant stakeholders affected by the issue, or possibly interested in taking part is

needed. Thus, when working with a wicked problem in which actors have not already assembled, the process is required to begin with narrowing down the problem.

Gaining an initial overview of the actors, processes, product flows, and value creation in the system prior to searching for possible solutions, proved to be central to the results of this research. Stroh's framework (2015) assumes the actors are from the onset in collaboration and can approach the problem by working to find solutions (Stroh, 2015). In the case of spent grain handling, obtaining an overview of the system was crucial to identify the range of actors and possibilities. The initial possible actors identified ranged from the milk producers to bakers and animal feed producers, who might have an interest in creating a product from spent grain. This overview was made before generating additional ideas for a solution, as the researchers gained insight into the industry and possible usage of the product through this process. Additionally, actors not initially identified were recognized later in the process. Through the interview process, the insight that spent grain could be used to feed insects which ultimately would be utilized as feed for fish farms emerged. When the system overview became clearer, potential pathways became apparent. Therefore, obtaining an initial overview of the system surrounding a wicked problem is essential to recognize possible solutions.

When working with wicked problems, the actors involved are not required to have the same needs, but their expectations of the future system must unify where the "mute" actor's interest is met. The term "mute actor" is referred to by the researchers as actors such as the environment or other stakeholders unable to "voice their opinion". According to Stroh (2015), it is essential to create tension between where the system is now and where the actors want it to be in the future (Stroh, 2015). Stroh introduces the "why question", aiming to create tension between where the actors are in their future, putting two contrary circumstances up against each other to underline the possibility of a better future scenario (see Table 3). In this research, it was problematic to use this method, as most of the actors engaged in the process, except for the brewery, were not affected by the issue of spent grain handling and thus had difficulty visualizing a superior future. On the other hand, the stakeholder benefiting most from an increasingly sustainable outcome is the environment, the "mute actor". However, the environment does not have the capability of envisioning a better future, and therefore the focus question was changed from "being more environmentally friendly" to "creating a higher value" (see Table 3). When exploring the viewpoint of the actors, their focus was centered around how they could

create higher value for themselves, which could create tension between the current reality and a future scenario where they have increased profits. Most of the actors in this project did not view themselves in the future where they act solely in the interest of nature, on the contrary, they could envisage themselves in a future scenario where they benefited from increasing sustainable actions. Thus, the importance is not that the actors who come together have the same vision of the future but that the obtained future is in the interest of the "mute" actor.

Table 3: The Why-question

"Why are the companies not exploiting the opportunity of profiting on spent grain while there is potential for a higher value?"

Identifying the type of motivation of actors prior to talking to them provides the opportunity to gain a preliminary overview of the possibilities of the solution(s) and thus which actors to engage. Stroh's framework recommends using the tools "Hidden vs Exposed Priorities" (see Table 5-8, Appendix A.ii) and "The Motivation Map" (see Table 4, Appendix A.i) to determine hidden and exposed motivations (Stroh, 2015). However, the framework assumes that the researchers already are familiar with the actors. Thus the researchers had difficulties estimating motivation prior to engaging the actors. This accounted especially for the actors not already committed to solving the issue. In the project, two types of motivations were identified among the stakeholders: (1) to fix an issue and (2) to gain additional benefits from a possible solution. In addition, the facilitator role had the motivation to create a system functioning better on behalf of nature. In the process, the insight showed that what the *motivation was for* is just as important as *depth of motivation*. Motivation can both be based on the need to fix an issue or to take advantage of an opportunity. An example is the pilot project between Arendals Bryggeri, Cernova Industri, and Felleskjøpet Fôrutvikling. The brewery is the only actor that needs the problem of spent grain to be fixed, which is their motivation to change (CFO of Arendals Bryggeri, 2022). Sometimes a solution can both lead to fixing an issue and obtaining additional benefits, such as for the research case where Arendal fixes its issue of spent grain handling while obtaining an additional

revenue stream. To Cernova and Felleskjøpet, solving this problem for breweries brings a financial opportunity through new revenue streams, and this is their motivation. The findings showed that actors, who had the most to gain financially on a solution were also pushing a project forward. On the one hand, financial motivation can lead to actors finding solutions, not solving the more pressing wicked problem. On the other hand, having the financial motivation and backing from the company can help acquire resources for the system change to happen faster, at a larger scale, and with deeper motivations from the company. Seeing a financial opportunity may also move actors from simply feeling a responsibility to act. This illuminates the importance of acquire an initial understanding of the different possible motivations of the actors involved in system change.

It is essential to rank the actors' motivation to understand their level of commitment to the process and identify which actors can play a crucial role in shaping a solution. It can be helpful to determine the different motivations of companies representing the same actor. For example, Sagene Bryggeri (brewery) was not as motivated to change as Arendal Bryggeri (brewery) was due to them having a more acute issue of spent grain handling they wanted to solve (CFO of Arendals Bryggeri, 2022). Stroh recommends using a tool where one ranks the already engaged group of stakeholders' motivation from -3 to +3 with. As the researchers did not have an established group from the beginning, the main reflection from this exercise is that it is difficult to guess the type and depth of motivations of an actor the researchers have not talked to for a solution that is not created. An example of this is filling in the motivation for a plant-based milk substitute. They are not in the current system, but research shows that internationally brewers spent grain had been used in plant-based milk substitutes. Early in the process, the intent was not to define the direction of the possible solutions. Therefore it was hard to fill in what actors would be the most willing to change. However, in the case of spent grain, the apparent loser in the system is the farmer, who loses the free animal feed. It was initially thought that milk producers could be interested in creating a plant-based product using spent grain. However, when talking to a Specialist in Raw Milk at Tine SA, (2022), the respondent expressed that he did not believe TINE would be interested in taking part in this project using spent grain as an ingredient in plant-based “milk”. The reasoning was that the production process would be complicated (Specialist in Raw milk at Tine, 2022). This misunderstanding underlines the uncertainty of filling in the tables before approaching the participants; one cannot anticipate the actors' standpoint. The primary purpose of determining the motivation of system actors is to remove the actor with no possibility or motivation

for taking part in the system change. Thus, ranking the different actors' motivations is useful in understanding each actor's commitment and then prioritizing actors of importance to deciding which actors to exclude as potential actors.

The planning of actor interviews is twofold: identifying the most suitable study participant and deciding the preferred order of actor interviews. One should be cautious about who the representative for an actor is in a system because it will shape the outcome. The researchers identified three levels of representation in the system. Within the system, there are stakeholders and actors. Companies represent the actors, and an employee represents the company. When interviewing the employees, their perspectives shape how the researchers see the company and the type of actor they present. As a result, the data gathered does not present the whole system, which should also be kept in mind later in the process when analyzing the data. As Stroh's framework assumes one already has identified and gathered the stakeholders, the framework does not mention the engagement order. This research found that the order of the interviews should begin with the most motivated and significant actors, as they might influence the direction. As the interviews were conducted and information gathered, the project was shaped and narrowed. If one starts interviewing the most motivated actors for change, their perspectives will also shape the process. As described, creating change will be more successful if the most suitable representative is chosen and the order of the interviews is organized based on importance.

2.4 Stage two: Facing Current Reality

The purpose of stage two, according to the framework, is to help people face current reality (Stroh, 2015). The stage is divided into two steps: (1) Building understanding through system mapping, followed by (2) Building support by bringing the system to life. The intended result from this phase is to build a shared understanding of what is happening and why and create acceptance of people's responsibilities for creating this reality (Stroh, 2015, p. 107).

2.5 Building understanding through system mapping

The key findings from applying this stage in practice are presented in this chapter as the following arguments: (1) The need for open interview questions, (2) The need for a facilitator to balance between sharing and not sharing information, (3) One can never get a real overview over an entire wicked system, (4) Need to identify a real motivation, (5) The process of following a framework for change is dynamic, (6) Need to establish real collaboratory possibility between actors, and, (7) Need to identify smaller solutions improving root issue.

The interview questions should be narrow enough to identify the issue and broad enough to get insights about the system from actors not directly involved. With basis in Stroh's interview guide, the researchers designed a semistructured interview guide with three key topics; the current reality, ideal future, and barrier to gett there. However, the questions did not work well to apply to people who did not have a related problem. An example is from the interview with a researcher at NMBU; when asked about system-level perspectives, he openly answered that he had never thought of the matter (Researcher and Professor bioprocesses at NMBU, 2022). However, he had researched the potential use of spent grain as sugar replacement when processed chemically. The researcher did not see himself in the system and thus not as an actor who could create change. Ideally, all actors should be asked the two core themes: how are you part of/how can you contribute to the system, and what is your stance on changing it. Thus, having a broad focus in the interview questions, aiming at all actors in the system, can involve actors or obtain helpful information from actors not directly affected by the issue.

The facilitator must find a balance between sharing too much and too little information to ensure participants are not steered in a direction while still understanding the project's motion. The researcher voicing their own opinion will affect the interview subjects in the interview process. However, the framework emphasizes that "advocating own views" is a method to make the actors understand different perspectives of a situation or system. In the interview process, the researchers presented facts the researchers found relevant to the different stakeholders in the system interviews but did not want to share potential solutions for their case to mislead them. For example, when talking to breweries, the researchers presented them with information about drying technology obtained after the interview with the CEO and founder of Waister, the company producing small-scale drying machines for spent

grain (CEO and founder of Waister, 2022). By sharing information, the interview subjects can get ideas of how they can act differently in their systems with the premises they already have. Therefore, the facilitator needs to share enough information to keep the interviewee's mind open while not directing the project in one specific direction.

One can never attain a real overview of an entire system surrounding wicked problems, however by talking to actors and mapping facts, one can get a deeper understanding. As the root problem is unknown or complex, organizing information and mapping out the system poses some challenges. The researchers' perception of the actual system is based on interviews and can never be the whole "truth". The scope of the case was simply a small part of the whole system and hence aims only at changing this part. To illustrate, a collaboration between Cernova, Arendal, and Felleskjøpet to create a new and more circular supply chain, can create small-scale changes in their respective industries. Yet, it will not solve the issue of spent grain handling on an industrial scale, national level, or global level, nevertheless, change occurs. To conclude, creating an overview of a whole wicked system is impossible, but one can, however, attain a deeper understanding of its behavior and structure.

It is essential to determine the real motivation of actors for taking part in the project, as the real motivation might not match what was previously guesstimated. Moreover, revealing the true motivation early on in the process might help prevent collaboration failure. In the framework, Stroh and McGah's introduce a table to reveal the purpose of actors. The tables were filled in before engaging actors (see Table 6, Appendix A.ii) and later with an established project group (see Table 7, Appendix A.ii). The second time the tables were filled based on data collected from the system interviews, and the researchers had identified three actors interested in changing the system. The table's usefulness increased as the quality of insight put in was more accurate. For example, when talking to the founder of the brewery Beer Flag he showed motivation to do something new with spent grain, but lacked knowledge of possibilities (CEO and founder of Beer Flag, 2022). Meanwhile, the assistant CEO of Svalbard Bryggeri provided information on their system change, burning spent grain to provide energy. Due to the Svalbard Environmental Protection Act (Environment Ministry, 2022.) they had already gone through the transition. Thus they did not have the motivation for changing their system (Assistant CEO of Svalbard Bryggeri, 2022). As the exposed purpose was clearly stated through interviews, it was also easier to estimate the hidden priorities. Factfull assumptions helped the researchers to understand

the actors' perspectives in the system. For example, before talking to a flour producer, which in this case was represented by Cernova, the researchers had no idea they would be the most motivated actor to change the handling of spent grain (CEO of Cernova Industri, 2022). Confirming motivation based on generalized assumptions with real insight will help establish a true collaboration possibility.

The process following a framework for change should be dynamic. Thus, one continuously has to include new actors and obtain and organize the information. In the research, notes were taken continuously throughout the process, and the findings discussed immediately after each interview. This was important because continuous understanding improved the insights along the process. Such as in an interview, Sagene said that they mix rice with the malt to dilute the beer's flavor, reducing potential uses of spent grain (Brewmaster at Sagene Bryggeri, 2022). With this added information, the researchers could ask Beerflag if they did the same, which they did not (CEO and founder of Beer Flag, 2022). When the insights of the system became more profound, the researchers could adapt the questions and methods to build on their inherent knowledge of the researchers. Thus, to create sufficient insights, the facilitator should go back and forth in the framework's steps.

When going forward with a group of actors, it is essential to establish real collaboration possibilities between them. It is not enough to have the same vision for a future system; one must be able to collaborate based on size, power dynamics, location, and resources available for the project. The framework did not mention this, as the framework assumes that the actors already collaborated before approaching Stroh for help. There could be parallel systems in the same system. For example, Cernova, Felleskjøpet and Arendal searched for appropriate technology for drying spent grain. One of the other participants interviewed was the CEO of Waister, a drying company specializing in spent grain (CEO and founder for Waister, 2022). It could have been a potential for matching these. However, their scales of production and technology did not fit. The size of the actor does matter when collaborating for change. Therefore, the facilitator must identify the match between the needs and resources of each actor to ensure a successful collaboration.

The facilitator needs to identify many potential paths forward to create the most feasible solution which aims for a shared solution to the root issue and meet the actor's problems. For wicked problems, there will never be one perfect solution. Therefore it is important to create many potential shared

solutions that can be building blocks for the path forward for the system. The facilitator must identify how the actors can “win” by implementing the solution and show them this. As there is no one right solution, the initiator should identify several potential shared solutions where everyone wins, especially the "mute" actor. Thus, the facilitator must identify smaller solutions in the interest of the actors, all bettering the root issue in the system.

2.6 Building support by bringing the system to life

The purpose of the second part of stage two according to the framework is to make the actors fully understand the insight from the system maps. And the intended result is “Engaging people in developing their own analysis builds ownership for the work and increases its accuracy” (Stroh, 2015, p. 142). The key findings from applying this stage in practice is presented in this chapter as the following arguments: (1) The purpose of system maps is twofold: Connect dots and convey solutions, and (2) The need to make actors think on a system level.

The purpose of system mapping is twofold; It is a helpful tool for the facilitator to connect dots within complicated problems, in addition to helping convey possible solutions to the actors. Stroh explains the purpose of system mapping mainly as a tool for storytelling. Days were used for understanding and creating the maps, and the insights developed helped the researchers understand archetypes of the system. This understanding was essential for the researchers to move forward. Secondly, the map helped convey challenges to the actors in the system to make them understand possible barriers. However, it was challenging to present the maps because many of the participants were not receptive to system thinking. The purpose of presenting the maps was to show the barriers and possibilities to the actors, which is essential for creating change based on the information gathered and shared. Thus, the method of system mapping has two purposes: aiding the facilitator in understanding the system itself and to present possible solutions to the actors.

System thinking can help actors see their role in the system and how they take part in improving it, therefore the facilitator needs to convey the theories of system thinking actively. The researchers saw that many participants did not have the ability or want to think on a system level. In addition, some

participants were not even receptive to understanding possible changes. The ones that were not directly affected or possibly could be affected by the issue of spent grain did not understand why they were asked questions about the system. This research showed that business leaders, especially, were not responsive to system thinking, as they are programmed to think of the company's best interest, not a collective solution. This was not a surprising finding, nevertheless an important one. How to change this perspective could have been an interesting paper in itself. It is not their role to see the overall connections, but system thinking helps to understand the true effect of their actions when they are the ones deciding to implement a change. The researchers found that most actors saw someone else as responsible for solving the problem, as it was not their business's core activity. The questions are then, "whose responsibility is it? And whose responsibility should it be?". System thinking can help the actors see that no one is taking responsibility, that someone should take responsibility, and see how to approach the situation from there. This shows the importance of the facilitator aiding actors to think on a system level to understand that their actions play a part in improving a bigger system.

2.7 Stage three: Making an explicit choice

The purpose of stage three, according to the framework, is to align diverse stakeholders with a common public purpose even though they may have private agendas (Stroh, 2015, p.155). This step aims to find out how one can help actors take actions to reach their goals. The intended result is to connect people more closely with their current realities and their aspirations. The key finding from applying the stage in practice is presented in this chapter as the following arguments: (1) The need for actor commitment to the process, (2) The need to convey benefits to actors, (3) The need for holes in solution to be filled, (4) Importance of facilitators awareness of own skills and knowledge as an influence, (5) The importance of a mediating role to balance power-dynamics of facilitator, (6) The need for clarifying expectations between actors, and (7) Importance of actors making an explicit choice together.

Actors should commit to participate throughout the whole process, to make the collaboration for system change successful. In Stroh's framework, it is assumed that the engaged stakeholders know they are part of a project aiming for system change. On the contrary, this research showed that the

participants did not see themselves as part of a whole process, as they had only agreed to partake in an interview. Collaboration is dependent on several actors, and thus it is essential to obtain some kind of commitment from system actors in the start of the process. Some actors are replaceable, while other actors' participation is crucial for success. For example, in the collaboration between Cernova, Arendal, and Felleskjøpet, Cernova is a key actor. With the solution being creating a new supply chain where spent grain is produced into animal feed through a drying process, Arendal can be replaced by other breweries. However, Cernova, with its big market share, cannot be replaced. Thus, to ensure a solution for system change is implemented, all the actors should be committed to the entire process.

The need for facilitators to convey possible benefits from a system change solution to the actor to create awareness of opportunities that exists, as the actor contributing to the root wicked problem might not have a directly related issue. The best solutions to complicated issues are not always the most logical or obvious solutions; thus, the actor might not understand the potential until they are enlightened. The research showed that many breweries did not have the time or resources to analyze better or worse solutions to spent grain handling. But if they got a better solution served on a silver platter, with more reliant pick-up times and additional profit, they would not say no. An actor from a different industry with no previous connection might not have seen the potential of brewers' spent grain. Such as Cernova entering the brewery industry while seeing the potential for spent grain as a raw material for flour (CEO of Cernova Industri, 2022). Hence, without creating awareness of the potential benefits from changing, the actors not aware of the issue cannot get motivated to create system change.

When deciding on a path for the system change implementation it is important to identify holes and fill them to create a complete plan for a future system, as there are multiple possible solutions to wicked problems. In the brewers' spent grain case, the researchers matched Cernova and Arendal to work together on the possibility of flour production from dried spent grain. Felleskjøpet was identified by them as a potential co-actor, as they saw more potential for faster scaling when working with animal feed. Even though the researchers as facilitators had a role in the project, it is essential that the actors themselves use their resources, network, and knowledge to fill the holes in the best possible way. Cernova invited Felleskjøpet to join the project. the researchers then tried to contact them for an interview to get system insight from them. However, as the researchers did not get to speak with them

privately, the researchers, thus also the research, lacked their perspectives. Gaining direct information from them could have given the researchers better insights to create a better solution for change. In the end, to implement a system change for a complex problem, missing pieces of the solution need to be filled.

It is important that the facilitator is aware of own skills and knowledge as an influence on shaping the outcome of the process for system change. The social capabilities of the facilitator, like the interviewing skills and the network of the facilitator/actor are all variables that can and will affected the outcome. To show the system maps in a good way, one needs knowledge of system maps, confidence that one can present them, and the charisma to persuade the audience. The researchers did not possess knowledge about system mapping and the archetypes. As a result, the maps were vague and not well communicated to the system actors. In addition, the knowledge about the system, the industry, the framework and system mapping affect the outcome. Furthermore, the researchers were also two researchers who had both the researcher and facilitator roles. The researchers therefore got to see firsthand how the personal traits of the facilitator shape the outcome. An example is that Eva focused on individuals in a system and Fam had a broader focus on actors/companies in the system. Throughout the process, the small details of how the facilitators act and reflect based on their knowledge shapes how the results of the framework unfolds. Ultimately, the skills and knowledge of the facilitators of a project for system change affects the outcome, and thus it is important that they are aware of their own limitations as a facilitator.

The facilitator of a process for system change must take an active role as a mediator so that actors do not overrule each other when making decisions based on existing power dynamics. Stroh does not address this issue directly in his framework, thus the researchers were not aware of its importance. The researchers found out later in the process that the importance of power dynamics is evident later in the process when deciding how to implement a solution. The power dynamic of the collaboration between Cernova, Felleskjøpet and Arendal shaped how the potential solution ended up. When the project group started their collaboration process, the researchers saw that the “mute” actor was not properly represented in the decision-making process. This illustrates the significance of the facilitator taking a mediator role when making an explicit choice for a system change solution, both for the actors involved but also for the interest of the “mute” actor.

Clarification of expectations between actors for a shared solution is essential especially because they have different motivations for creating the change. The researchers found that clarifying expectations was helpful in the kick-off meeting (Pilot-project group: Cernova, Arendal and Felleskjøpet, 2022). The clarification of expectations included: determining why each actor is present, what they want to bring to the table, which vision they see for the project, and what kind of ownership and role they want to have. A result is that Arendal expressed their wish to prioritize the burning of spent grain for energy before drying and selling (ibid.). In addition, Cernova and Felleskjøpet communicated that they depend on more breweries for larger volumes and cannot be exclusive with Arendal (ibid.). By discussing these things, one makes sure that the plan/vision is shared. It is essential to also discuss what *should* be done and divide roles, actions, and responsibilities to make sure the change happens (ibid.). To conclude, a clarification of expectations between actors is key to make an explicit choice for a path forward that all actors agree on.

The actors' decision when making an explicit choice to create system change needs to be made together, to create shared ownership and prevent misunderstandings. In this research case, the decision on a solution did not happen with the initial actors. Initially the researchers put Cernova and Arendal together, and they decided to collaborate. Then Cernova invited Felleskjøpet to the "kick-off" meeting, where they planned what to do. Following the framework's path, Cernova implicitly decided to approach the issue of spent grain handling. As a result, Cernova got most ownership of the project and decision power. This shows the importance of the system actors making the decision together to prevent misunderstandings in the aim of the project and to create a shared ownership.

2.8 Stage four: Bridging the gap

The purpose of stage four according to the framework is to bridge the gap between where a system is and where the actors want it to be. The intended result is to “identify leverage points to bridge the gap and establish a process for continuous learning and outreach.” (Stroh, 2015, p. 165). The key findings from applying this stage in practice is presented in this chapter as the following arguments: (1) The need for an action plan, (2) Leverage is mirrored by action taken, (3) The need for a key actor to finalize the project and implement change and (4) System change is not a linear process.

The need for a specific action plan is evident, as real system change cannot happen if clear responsibility and tasks are not divided amongst actors. As the collaboration started rather organically, Cernova took charge of organizing communication, meetings, and project management for the project members. Thus, the researchers were not taking action to implement the solution but focused on observing what steps were taken. This demonstrates that some actors in the system of spent grain handling took responsibility for creating change without an active facilitator. In the initial kick-off meeting between Cernova, Felleskjøpet, and Arendal, project groups and rough responsibilities were divided (Pilot-project group: Cernova, Arendal and Felleskjøpet, 2022). However, not much progress happened in the following weeks (obod.); this shows the importance of a specific action plan. This illustrates the importance of creating an action plan for implementing system change.

The leverage of the action implemented for system change is mirrored by the action taken. For example, the researchers tried to change the system of spent grain handling by focusing on creating more value through circular product development, and creating new relationships across industries. Thus that is also what the research achieved. The collaboration between Cernova, Arendal, and Felleskjøpet had the purpose of making spent grain into flour. The research could also have focused on changing the system on a deeper leverage point, such as changing the rules of a system. Then it would be natural to aim at involving actors such as politicians and lawmakers. To conclude, type of change aimed for shapes the outcome of change achieved.

It is important to find a key actor taking responsibility to ensure the actual system change is implemented. At the beginning of the research, the researchers did not understand the importance of a host. In one of the mentor meetings, Stroh highlighted the importance of a host engaged in the issue of spent grain handling to guide the direction of exploration (Stroh, 2022). Without a host it was challenging to define who the focusing question should be aimed for and which stakeholders were relevant to the interview. The researchers looked at potential solutions for spent grain handling ranging from producing biofuel, pulp production, plant-based milk, or animal feed, until the researchers found the key actor Cernova. When a key actor driving the process was found, it was easier to narrow down the focus. They took charge at the end of the framework, leading the project forward, as they had the resources to do so. This underlines the importance of a project key actor, driving the project forward and actualizing the change after the researchers leave the project.

The process of system change for wicked problems is not linear as one can often “go back” and improve the problem with other solutions. In the research project tackling spent grain handling, the researchers could have aimed towards implementing changes of the system through bioenergy, insect feed for salmon production, or natural pulp products. However, the researchers followed the trail that seemed the most promising, considering the actors interviewed and their motivation. The premise of wicked problems is that there are multiple strands of the root issue and thus also multiple possible solutions. There is no right and wrong, only better and worse when trying to solve wicked issues, and one will never solve the problem completely. To better the issue as much as possible, aiming to solve the issue is continuous and never-ending. The researchers believe the issue of spent grain handling can be improved with the solution found, but there are numerous solutions one could implement, and the issue is only solved for one group of actors, while there are endless networks of actors that still have the issue. As an example, if Cernova dries spent grain, they also have the potential to use their infrastructure and system insight created to work with more breweries and later do the same process for brewers' spent yeast as well. Both the Chief of development at Ringnes and the Brewmaster at Macks Ølbryggeri mentioned this potential (Chief of development at Ringnes, 2022) (Brewmaster at Macks Ølbryggeri, 2022). This is not the same raw material, but the issue of circularity is still there, and by using existing knowledge and resources, doing the process again would be cheaper and faster. This illustrates the importance of not settling with a system implementation; as the process should continue and be redone.

2.9 Summary of results

Stroh's framework helped guide through a process aiming for system change. It gave a guideline for starting and tools to lean on throughout the process. Working with soft systems, his methods for understanding mental models and creating awareness helped identify how to approach and work with the system.

There were some challenges when applying the framework to practice when working with wicked problems. The main concerns are: (1) the need for an initial overview, (2) the importance of mapping

and rating the motivation, (3) using the frameworks should not be linear, (4) and the importance of a neutral initiator and driving actor taking over the project.

Firstly, an initial overview of the system is essential when considering wicked problems, as one does not know the specific problem and thus does not know the specific actors. Actively mapping out an overview to determine these two is thus needed to approach the issue.

Secondly, the researchers found it important to map and rate motivation for change for the different potential system actors to be able to prioritize engagement and direction of research. Stroh does mention this with some example tools, but the researchers saw it as especially important when trying to approach wicked problems, as the actors are not identified from the starting point.

Thirdly, by applying Stroh's framework, the research found that the process of system change should not be approached as linear. As one does not know the solution, there will be gaps in the solution when a path is chosen, and the step should therefore be re-done, making the process dynamic.

Lastly, one of the most important conclusions in the findings is the question of having a host or not having a host. When trying to approach wicked problems where no one is taking responsibility, there should be a neutral initiator that can spark the beginning of a system change journey. The initiator can voice the interest of the "mute" actors in the system, such as the earth when it comes to climate change. It is also important to have a driving key actor in the specific system to initiate and follow through with the change. However, the issue might occur with uneven power dynamics leading the project in their favorable direction. Nonetheless, both an initiator and a host are important.

This research revealed the need for a framework that builds upon Stroh's work based on these points. A new, simpler, and compressed framework is created. The researchers hope it can complement Stroh's - and other - frameworks when changemakers face the challenges of bettering wicked problems.

SYSTEM CHANGE THROUGH COLLABORATION FOR WICKED PROBLEMS

A new framework is developed based on reflections obtained through applying the *Systems Thinking for Social Change* into practice. The framework is called *System Change through Collaboration for improving Wicked Problems*, and aims at creating solutions that will improve wicked problems, especially for the passive stakeholders (e.g., nature).

2.1 Background of the new framework

The framework aims to create collaboration for system change aiming at a win-win scenario for all actors involved in the process. Simultaneously it addresses the root issue of the wicked problems (e.g. climate change, poverty, hunger), advocating for the passive stakeholders without the possibility to voice their opinion.

It is impossible to solve the root issue of wicked problems. However, one can work on changing the system for the better. In this framework, a shared future is created by solving the different actors' issues to improve the root problem. The actors can have three different issue levels to consider when working with the framework. The first is the actor with a burning issue that needs to be solved quickly. An example from the research is Arendal Bryggeri, who needed to fix the issue of spent grain handling, not to stop operations or lose money (CFO of Arendals Bryggeri, 2022). The second type of issue arises when the actor can gain potential benefit by solving a future issue. For example, Cernova and Felleskjøpet both gain a new cheap, local raw material source. Lastly, the third actor issue is the "mute" actor, which has an issue that is rooted in a wicked problem. This issue cannot be solved, only

improved. For the brewer's spent grain example, the "mute" actor is the environment, and the solution is circularity and minimizing the strain on resources. The third actor is represented by an initiator.

There cannot always be a win-win situation for everyone in the system. However, the framework aims to make a scenario where all involved in the project, especially the "mute" stakeholder that normally loses, get a better future. An example is the brewers' spent grain handling case. The farmer is the "loser" of an alternative system, as he will not get free spent grain as animal feed anymore (Brewmaster at Sagene Bryggeri, 2022). However, the aim is that more benefits than losses occur due to economies of scale, collaboration, sharing costs, etc. The actors benefitting from an alternative solution can both gain short-term or long benefits. However, they most likely need to invest time, resources, and money to create change, thus having short-term losses and benefiting long term. When it comes to the actors that need to fix an acute issue, they are both short and long-term winners.

2.2 Criteria of framework

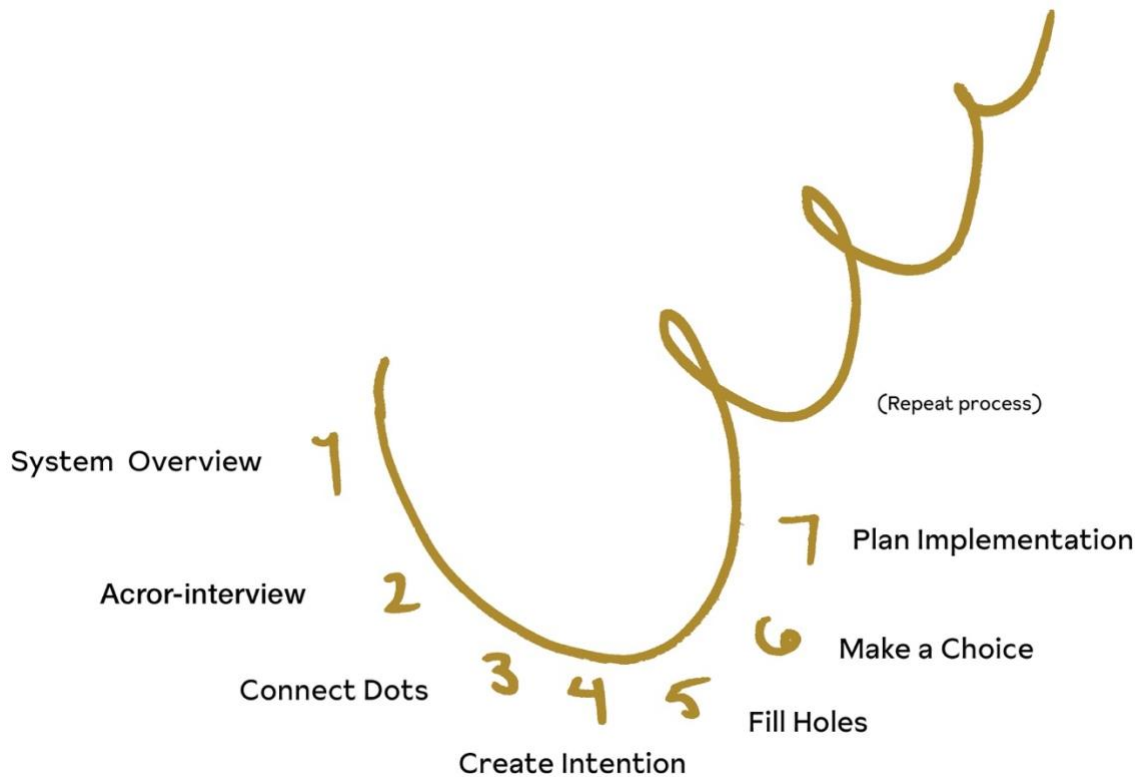
A few criteria should be met before applying the framework to practice to get the most successful result. First, the starting point must be a wicked problem. Secondly, there need to be one or several initiators of the project. The initiators should have their primary goal to improve a wicked problem, meaning that they have a philanthropic motivation to create change. Hence, the initiator needs to be neutral and thus should be paid by a neutral external actor that does not have direct leverage to shape the path of the solution. Thirdly, there should not be a host (main actor) from the beginning, but one should emerge during the process to continue without initiators in the end. The initiator supplements the host, creating a power dynamic favoring the mute actor in the wicked problem. Fourth and foremost, the framework assumes that the initiators use tools from their toolbox when following each step. An example is that when one should gather insights, this can be documented in an excel sheet or through design processes, depending on which toolkits you are familiar with. This is simply a framework.

The framework is scalable. Depending on the timeframe, the project is encouraged to enter stage four midway in the process. This way half time is used to get to know the system, and the second half is used to shape an alternative reality. In addition, some milestones need to be met along the process. Fulfilling these are, of course, more essential than the time used. The key milestones include: creating a project brief (stage 1), lock network of actors (stage 4), and lock solution (stage 6). Similarly, the representatives of the actors can also be scaled. For example, the interviews can either be done one-on-one, or they can be meetings representing larger companies with more people presenting each actor. The main purpose is to identify their motivation.

2.3 Structure of framework

The framework has eight stages (see Figure 10) where seven are core. The stages are: (1) System Overview, (2) Actor-interviews, (3) Organize Information, (4) Intention Meeting, (5) Identify and Fill Holes, (6) Decision Meeting, and (7) Action Plan. Stage 8 is not a framework stage but rather a recommendation to re-do the whole process, as system issues are never solved. The stages all have one key recommended method, such as desk-work, actor-interview, or actor meetings, but the aim of the step is the most important. The methods and tools can vary depending on the complexity of the issue. The framework's purpose is not to analyze all possible solutions to find the best but rather to create a good solution and then implement it. While doing so, the stages can be re-done, and every time one goes through the framework, the wicked problem will be improved.

Figure 10: System Change Through Collaboration for Wicked Problems



2.3.1 Stage one - System Overview

The scope of the first stage is to start with a wicked problem and identify the “mute” or passive actor. This stage aims for the initiator(s) to gain an overview of the system concerning a specific wicked problem and narrow it down to a more specific system issue. For example, when considering the wicked problem of “war”, the "mute" actor could be the children trapped in war. When working with problems where no one feels ownership, the initiator should start with the bigger system structure. When this is established, one can move forward by finding a group of motivated actors. The initiator(s) should create a drive for change among the actors identified. At the same time, by understanding the system, the initiator can establish which actors have the motivation to work with the wicked problem. The initiator gets an overview of the system through this step, essential for considering possible actors

to engage. The criteria that should be met before conducting this stage is that the initiator has a philanthropic motivation, as it is essential to represent the interest of the "mute" actor. The key method for this stage is desk work. This is because desk work is needed to do preliminary system research.

2.3.1.1 Create a system overview

The first action of the first stage is to create a system overview. The purpose is to get an overview of actors, product flows, processes, and value exchanges in the system. In addition, it is to identify actors in the system and how and with whom they operate. Developing an initial overview of the system is essential for considering all possibilities and understanding which actors to engage.

The number of actors to engage later depends on the system limits such as timespan, geographical scale, and problem complexity. How broad or narrow the pool of actors are depends on these variables. For example, considering the case of the brewers' spent grain system and a time limit of two months, it makes sense only to invite the most promising actors to create an alternative system within the food and animal feed production. However, one could have a range of actors related to a broader pool of options with more time. In this research case, this could be natural fiber pulp producers, renovation services, or machine producers. This would have taken more time but also given more potential solutions. The intended outcome of the overview is to identify relevant actors of the system of the wicked problem and narrow down the scope to a more specific issue.

2.3.1.2 Identify and rank motivation

The second action of the pre-stage is first to identify which information you are missing, who can provide this information, and guesstimate the different actors' type and level of motivation. It may feel like shooting in the dark early in the process, but the further into the project one comes, the easier it gets to identify these. The purpose of step 2 is to know whom the initiator should talk with, and which actors might have the most incentives to create change in the system. This will help decide which

actors are relevant to the interview, and the preferred order of interviews. The three types of motivation of actors for change are: (1) to fix issue, (2) to gain additional benefits, (3) philanthropic. As the interviews are not done yet, the tool used must be done based on estimated guesses. Identifying and ranking the motivation of the system actors from most relevant to less helps identify which are the most important and which to prioritize.

The overall result of stage 1 is to have a complete overview of the system surrounding the wicked problem with the actors assumed to be motivated for changing. In addition, it should estimate the type and range of motivation of the system actor to change the system for their benefit. To get the highest likeliness of a successful process, one should interview and gather actors with motivation to change. Make sure to be cautious about whom one chooses to represent the actor for the rest of the project.

2.3.2 Stage two: Actor-interviews

The scope of this stage is a specific system issue concerning the wicked problem and the chosen “mute” actor. Based on the desk-work conducted in the previous stage, one has now narrowed down the perspective. For example, one may have narrowed down the scope from “children and war” to “children's education in war”. The purpose of this stage is twofold. Firstly, the initiator needs to obtain information about the specific system the initiator aims at improving. Secondly, the initiator needs to establish the real motivation actors have for change. The criteria that need to be met before starting this stage is that the initiator(s) have chosen interviewee subjects representing the system actors. Moreover, the initiator needs to believe the interviewee can give insights into the system or be motivated to participate in the project. The key method for this stage is the actor interview. The interviews are important in narrowing down the system issue to find individual ac, as identifying core, motivated actors will shape the pool of possible solutions further down.

2.3.2.1 Interview Preparation

The first action in stage two is to prepare the actor interviews, which is done by creating an interview guide and inviting relevant interviewees. This should result in a semi-structured interview guide with open questions, possible to adapt to each interviewee. When adapting the interview guide for each interviewee, the initiator must ask themselves (1) “Which information do I believe this interviewee can provide?” and (2) “How should I ask the questions so that s/he provides this information?” The method used to prepare for the actor- interviews is to create a solid interview guide and invite the preferred interview subjects. The interview guide should include questions about the actor and the current system. It should also include the future scenarios they can imagine and which actors they see as relevant.

The stakeholders likely have different problems to solve. These problems may not be directly linked to the issue investigated. It might be beneficial asking the actors who *they* thought is beneficial to talk with. An example of this is from the brewers spent grain system. A biologist was asked which possible uses of brewers spent grain he could think of, and which actors could be interested in looking into this. He then talked about changing the structure of spent grain to a sugar replacement and proposed an actor the researchers could contact about this (Researcher and Professor bioprocesses at NMBU, 2022). When inviting interviewees start with the actors with the most motivation and leverage. This lets them shape which questions become relevant in later interviews. Although the main analysis and organization happens in the next stage, initial analysis happens throughout as this is a dynamic process. The outcome of the preparations is a solid interview guide and planned interviews with the preferred interview subjects.

2.3.2.2 Conduct interviews

The second action of stage 2 is to conduct the actor interviews. The purpose of actor-interviews is both to (1) map the actual motivation of the chosen system actors confirming or disconfirming the assumptions and (2) to obtain in-depth information about the system, to see all the pieces of the system. The key actors will be the ones with either a direct issue related to the system issue or the ones that will benefit from a system change. However, some interview subjects should be invited to provide

more knowledge about the system to get the best overview but are not direct change-makers in the change system. The actual system overview that will emerge based on the interviews is a more tangible and a more real representation of the system. However, be aware that one can never map the entire truth of a system.

The suggested method for the actor interviews is to conduct one-on-one interviews. Use the semi-structured interview guide with system questions. Be cautious of how and what you share with interviewees because that will affect their train of thought, and the interviews aim to get the most complete picture of the system and the system actors and change possibilities. There are three levels of representation that influence the perception of actors of the actual system: (1) study participant, (2) company, (3) stakeholder/actor. Keep in mind the information loss that may occur with each layer when noting down and analyzing the answers during the process. The outcome of conducting interviews is a set of raw data about the actors and their perspectives on the system. In addition, initial patterns and ideas for a solution should have been attained.

The overall outcome of this stage is a broad overview of the actual system with actors motivated to change, and many possible directions. Note, when talking about the “actual system”, it is important to understand that it is only the most accurate description of the system, based on the subjective answers of interview subjects from the interviews. One can never gain all insights, but by learning new perspectives, one can see a more tangible and real picture than initially assumed/guessed based solely on research and generalizations. In addition, the data about the real motivation of the actors can be used to organize actors from most relevant to least relevant to know which is most important and which to prioritize in the rest of the process.

2.3.3 Stage three - Connect dots

The scope of this stage is an overview of possible actors and paths to solve system issues. To use the same example as earlier, possible paths to solve the issue of children's education in wartime could be: 4G online education, boarding schools, or underground schools. This stage aims to analyze the

interviews and outline possibilities from the interviews. Doing this will make it easier to concretize the possible paths for an alternative system where all the involved actors benefit. The criteria that need to be met before starting this stage is that the initiator needs to make sure the actors chosen for further collaboration are matched with each other considering power relations, size, and real motivation. The key method of this stage is analyzing and organizing the data through desk work.

2.3.3.1 Organize information

The first action is to analyze the interview-data into objective facts, storylines, and connections. The purpose of the analysis of data is both to (1) rate the actual motivation of the chosen actors, and possibly trash the ones without motivation, and (2) to improve the system overview with actual data. By confirming or disconfirming the actual motivation of the system actors, it will be easier to narrow down the focus for the future system, and by improving the system overview with real insights, the solutions will be the most realistic and feasible. The outcome of the analysis is to know what actors to continue with and get a better idea of the path for possible future systems. Factors to consider while deciding which actors to continue with are motivation, power-dynamic and sizes, and possible collaboration.

2.3.3.2 Outline possible solutions

The second action of stage 2 is to outline possibilities based on the information into possible paths for solutions to system change. The purpose of action outlining possible paths is to create a portfolio of shared solutions where everyone wins, including the "mute" actor. Here, the initiators need to see patterns and use the motivation of actors and information of the system to find mutual potential paths forward. The outcome is a portfolio of shared solutions for an alternate system based on the system actors wishes and preferences, resources, and connections. The overall outcome of this stage is an improved overview of the system issue with actors motivated to change. Information of different paths of solution with shared aim, as well as benefits of solution per actor. Creating several potential shared

solutions where everyone wins, including the "mute" actor. These different solutions will be presented in the next stage to the actors.

2.3.4 Stage four - Create intention

The scope of this stage is to consider all the possible solutions of the individual actors. Going back to the children in war example, the actors chose to create an online school, as they are most motivated to implement that solution because of less risk, more revenue and it will help the most children. This stage aims to commit to the process and together discuss possible solutions. The role of the initiator is to make the actors understand that they can eat the cake and have it too. When deciding on a solution with the actors, the initiator must let them conclude how they want the project to be. In this step, the initiator must show the actors the findings, give them ownership of the process, and simultaneously shape the actors' visions. The criteria that need to be met before entering this stage is that the system actors are willing and able to collaborate in the same frames as the others. The method of this stage can be called a solutions workshop, as its aim is for all the system actors to decide on a solution for change, they all benefit from by meeting and discussing different perspectives and ideas.

2.3.4.1 Actor Engagement

The first step in stage 4 is for the initiator to invite the relevant actors to the intentions meeting and ask them for consent to be part of the rest of the process. The initiator must convey solutions that benefit all actors involved. The benefits can be short or long term, based on economics, logistics, values, or other benefits. The purpose of engaging the actors is to make sure that they are motivated to take part in a project and implement change.

The initiator should ask the representatives of the actors for consent that they have the intention of being part of the whole process. It is important to simultaneously be transparent about the direction of the solution and the actors involved, so that they can make an informed decision. Getting consent

should be done by asking if they are willing to investigate the possibility of participating in a project working on change. Next the actors need to define one future system and individual solution(s) they aim to work on together. In this process, the initiator should take an active role to make sure power dynamics do not derail the solution's direction and the “mute” actor is not forgotten. The outcome is a motivated group of actors prepared to collaborate with others to create change in their system.

2.3.4.2 Setting the intention

The second action of stage 4 is to gather the actors to set the intentions of the process. The initiator(s) propose their findings and idea(s), followed by facilitating a discussion where the actors together decide on a shared future they want to continue with.

The purpose of this gathering is both for the initiators to convey their finding of the system, and connections so the actors get a more holistic overview, and for the actors to make an informed choice together, considering themselves but also the others in the system, as well as the “mute” actor. The purpose of the initiator presentation is (1) to convince the actors that they can benefit from changing, and (2) to make them think on a system level. Based on this they will discuss and make a decision for a future system.

The initiator needs to convey the benefit for the individual actor from the possible solutions, as they might not be aware of a better option. This is both relevant for actors with an issue related to the system problem, and the actors that can benefit from an alternate system. Actors with a burning issue might currently have a quick fix and not be aware of better solutions, so they also need to be convinced. Convincing is most important for the actors without a current problem, and can benefit from a new system, as they may not even be in the current system or supply chain, and they need real motivation to change.

In addition to conveying the system overview and the individual benefits for each actor, the initiator should convey theories relating to system thinking to make them understand how everyone is

connected, and thus grasp the real effect of change. Furthermore, helping the “mute” actor obtain a preferred solution, might be additional motivation for them to do something for society as a whole. Since the facilitator of this step first must convince the actors that the proposed solution(s) are beneficial for them, it is appropriate to facilitate a discussion where the actors agree upon a shared future together. The intended outcome is an agreement on direction of solution, merged by feedback, priorities, wishes and demands of the different actors for a new future system. The overall outcome of stage 4 is an initial agreement from relevant actors to continue to collaborate for specific change.

2.3.5 Stage five - Identify and fill holes

The scope of stage 5 is to continue with the rough solution from the previous stage, and then fill in the gaps that are missing for a complete solution. For example, the online school for kids in wartime lacks an IT company or a legal team to make the solution complete.

The purpose of stage 5 is to go forward with the network of actors that have agreed to be part of the project and to fill the holes in the agreed-upon solution. The initiator(s) can jump back and forth in the process to obtain actors, resources and information needed to make the solution as complete as possible. But it is also important that the already committed actors contribute to this process as they might have a larger network in the industry, society, existing knowledge, and other resources that will be relevant. The criteria that need to be met before starting this step is that the actors who gave consent for taking part of the project are willing and motivated to use their time, resources, and network to help fill in the gaps and make the solution complete. The key method for this stage is desk work. This is because the initiators need to step back and analyze all the data obtained from the “setting the intention” gathering and look at it holistically together with the system overview to determine the holes in the solution. In addition, if the initiator re-do stages 1-3, some interviews should be conducted.

2.3.5.1 Identify and fill holes in the solution

To identify and fill holes of the determined solution the initiator first needs to identify what is lacking. The holes might include missing actors, crucial information, or lacking resources. When the holes are identified, the initiator needs to fill the holes. The purpose of doing this is to create a complete solution together with the established project actors. The process of creating system change is not linear, thus, one should always balance making decisions and moving on, and being critical and re-doing steps.

The following steps should be done: get an overview and do research (stage 1), interview potential actors that can be good additions to the mix (stage 2), organize/outline possibilities information to make them fit into the shared future system with their own solution. This process should be done by the initiator(s), but with close communication and help from the involved actors. The outcome of this step should be filling in the holes that the initiator could not have foreseen when initiating the process. The overall outcome of this stage is to fill in the holes to create a more realistic and complete solution. Doing so prepares the stakeholders to move forward to make an explicit choice.

2.3.6 Stage six - Make a choice

The scope of stage 6 is to concretize the solution from a rough alternate system to make an explicit choice for the path forward. Going back to the children's education in wartime example, and the solution being the online school, the driving actors need to decide what the timeframe is for having the school up and going, what are the costs, what actors are in charge of what actions, and who owns the project.

The purpose of this stage is to decide what the specific change should be. In this stage the initiator should make sure the power dynamic is in favor of the “mute” actor, at the same time as all the network actors get their preferred solution. The actors must get a clarification of expectations from each other and understand the shared goal for collaboration. The criteria that need to be met before entering the stage are that all the actors feel ownership of the idea, to be able to realize it, and to make it successful. The key method of the stage is the decision meeting(s). This can be one or several meetings to make the actors agree on the path forward.

2.3.6.1 Make actors decide

The first and only action of stage 6 is for the initiators to host decision meeting(s). The purpose of this gathering is to decide upon a shared specific system change where all actors involved see themselves as winners in the new system. The initiator(s) makes sure that the “mute” actor also wins. The solution must be made in collaboration. The initiators should facilitate a shared clarification of expectations, agreeing on the goals for collaboration, dividing of roles and responsibilities, deciding a timeframe and ownership for the project. The outcome of this step is to identify expectations of the project and make an explicit choice to actually implement the change.

The outcome of this stage is to make an explicit choice for the alternative system. The actors need to lay the groundwork regarding which resources each actor should contribute with, their expectations, and a specific goal. This is essential before they create an action plan for implementation in the next stage.

2.3.7 Stage seven - Plan implementation

The scope of stage 7 is to lay a specific plan to implement the chosen solution. The online school for children in war has an opening date, milestone activities such as developing curriculum, programming, divide responsibilities, activities, and due dates per actor.

The purpose of this stage is for the system change to be implemented by developing a specific plan. Based on roles and responsibilities decided previously, decisions should be made based on the expectations and timeframe decided in the previous step. The criteria that need to be filled before conducting the stage is that all the actors keep the intentions, as the collaboration is dependent on the actors for success. The key method of this stage is for the initiators to host action plan meeting(s) with all the actors.

2.3.7.1 Facilitate for action planning

The initiator needs to gather all the actors and together create an action plan for the implementation of the system change. The purpose of the action plan is to make sure that the project moves forward in the direction that is agreed upon. Grounding the project in a plan helps identify milestones to be reached and establish when each actor needs to do what. There are many existing project planning tools, choose the one most fitting for the size, industry, and field of the relevant system. With a solid project implementation plan, the solution and the actor's motivation to change are strong enough to continue on their own. The overall outcome of this stage is a specific action plan, ready to release the project out in the world without the initiators.

2.3.8 Stage eight (or ∞) - Repeat process

Following this framework may lead in unexpected directions. Systems are dynamic, and wicked problems cannot be solved, only improved. Wicked problems have numerous possible solutions, and the system change created from using this framework can always be improved. Therefore, all actors involved including the initiator should continue using their obtained knowledge, repeating the whole process constantly. For each loop they successfully go through, the wicked problem will (hopefully) be improved. The purpose of this stage is ultimately to create a better system, where the initiators are motivated to continue the process, or give the “relay stick” to the next initiators and the actors involved.

CONCLUSION

The aim of this thesis has been to investigate how a framework for creating system change in practice concerning wicked problems should be. The underlying research questions aimed at the use of methods in Stroh's framework, and how it could be improved for wicked problems in practice. The purpose of answering these was to supplement existing frameworks with further insights about system change in practice. By doing so, more practitioners can learn the skills needed to change systems.

The result of the action research underlines that system change is possible within a short amount of time, as the researchers managed to create change. However, the researchers were still working within the realm of the current systems centered around capitalism, thus a lot larger system changes need to occur to better the sustainability path the researchers are on. Investigating this the researchers saw that it is not only needed more research on these topics, there also needs to be more practitioners.

The main findings from the research considered when applying a framework in practice to better wicked problems. The key findings include: (1) the need for an initial overview, (2) the importance of mapping and rating the motivation, (3) using the frameworks should not be linear, and (4) and the importance of a neutral initiator and driving actor taking over the project.

The new framework developed as a result of the research addresses these issues. Firstly, a pre-step is added to the new framework to create an initial overview of the system, aiming at identifying the best system actors for creating system change. Then it adds the point of identifying and rating the motivation of possible actors both before the interviews, and after talking to them, to make sure the project is feasible. The new framework has the assumption that there needs to be a neutral initiator to make sure the interest of the "mute" actor is met. At the same time, it underlines the importance of finding a driving actor (host) to take over to finish the process. It includes stage five (complete final solution by filling in holes) and stage eight (continue the never-ending process) to make the framework non-linear, which is essential for the process of bettering wicked problems. The purpose of the framework developed in this thesis is ultimately to create a better world, where more and more people recognize the positive change they can have on the systems inhibit

BIBLIOGRAPHY

- Abson, D., Fischer, J., Leventon, J., Newig, J., Lang, D., Schomerus, T., Vilsmaier, U., von Wehrden, H., Abernethy, P., D. Ives, C. and Jager, N., 2017. Leverage points for sustainability transformation. [online] 41(1), pp.30-39. Available at: <<http://europepmc.org/article/PMC/5226895>> [Accessed 11 April 2022].
- Ackoff, R., 1994. Systems thinking and thinking systems. *System Dynamic Review*, [online] 10(2-3), pp.95-335. Available at: <<https://onlinelibrary.wiley.com/doi/epdf/10.1002/sdr.4260100206>> [Accessed 12 May 2022].
- Adams, R., Jeanrenaud, S., Bessant, J., Denyer, D. and Overy, P. (2016) 'Sustainability-oriented Innovation: A Systematic Review', *International Journal of Management Reviews*, 18. (Accessed 21 November 2021)
- Aengenheyster, M., Feng, Q., van der Ploeg, F. and Dijkstra, H., 2018. The point of no return for climate action: effects of climate uncertainty and risk tolerance. *Earth System Dynamics*, [online] 9(3), pp.1085-1095. Available at: <<https://esd.copernicus.org/articles/9/1085/2018/>> [Accessed 8 May 2022].
- Agyemang, M., Kusi-Sarpong, S., Khan, S., Mani, V., Rehman, S. and Kusi-Sarpong, H. (2019). Drivers and barriers to circular economy implementation. *Management Decision*, 57(4), pp.971-994.
- Anagnou, E. and Fragoulis, I., 2014. The Contribution of Mentoring and Action Research to Teachers' Professional Development in the Context of Informal Learning. *Review of European Studies*, [online] 6(1). Available at: <https://www.researchgate.net/publication/271060421_The_Contribution_of_Mentoring_and_Action_Research_to_Teachers%27_Professional_Development_in_the_Context_of_Informal_Learning> [Accessed 7 May 2022].
- Antikainen, M. and Valkokari, K., 2016. A Framework for Sustainable Circular Business Model Innovation. *Technology Innovation Management Review*, [online] 6(7), pp.5-12. Available at: <<https://www.timreview.ca/article/1000>>.
- Arranz JI, Miranda MT, Sepúlveda FJ, Montero I, Rojas CV. Analysis of Drying of Brewers' Spent Grain. *Proceedings*. 2018; 2(23):1467. <https://doi.org/10.3390/proceedings2231467>
- Assistant CEO of Svalbard Bryggeri AS, 2022. *Masters Project - Beer and the Future of Food* [Interview]. Conducted digitally over Zoom.com with E. Nagelhus and F. Leborg, 16. February 2022.

- Associate professor Husfyrfag at NMBU, 2021. *Interview in relation to subject "INN340 Entreprenørskap i Praksis"*. Conducted with E. Nagelhus and Oda R. Danielsen, Semtember 2021.
- Barić, A., 2017. Corporate social responsibility and stakeholders: Review of the last decade (2006–2015). *Business Systems Research Journal*, [online] 8(1), pp.133-146. Available at: <<https://doi.org/10.1515/bsrj-2017-0011>> [Accessed 3 May 2022].
- Baskerville, R. and Wood-Harper, A., 1996. A Critical Perspective on Action Research as a Method for Information Systems Research. *Journal of Information Technology*, [online] 11(3), pp.235-246. Available at: <http://file:///Users/famleborg/Downloads/Baskerville_1996_critical%20perspective%20on%20action%20research.pdf> [Accessed 4 March 2022].
- Bastianoni, S., Coscieme, L., Caro, D., Marchettini, N. and Pulselli, F., 2019. The needs of sustainability: The overarching contribution of systems approach. *Ecological Indicators*, [online] 100, pp.69-73. Available at: <https://www.researchgate.net/publication/327064595_The_needs_of_sustainability_The_overarching_contribution_of_systems_approach> [Accessed 11 April 2022].
- Battisti, D. and Naylor, R., 2009. Historical Warnings of Future Food Insecurity with Unprecedented Seasonal Heat. *Science*, [online] 323(5911), pp.240-244. Available at: <<https://www.science.org/doi/10.1126/science.1164363>> [Accessed 4 May 2022].
- Bedau, M., 1997. Weak Emergence. *Notis*, [online] 31, pp.375-399. Available at: <<https://doi.org/10.1111/0029-4624.31.s11.17>> [Accessed 1 April 2022].
- Bell, E., Bryman, A. and Harley, B., 2019. *Business Research Methods*. 5th ed. Oxford: Oxford University Press, pp.353-538.
- Bell, E., Bryman, A. and Harley, B., 2019. *Business Research Methods*. 5th ed. Oxford: Oxford University Press, pp.3-61, 163-353.
- Binswanger, M., 2009. Is there a growth imperative in capitalist economies? a circular flow perspective. *Journal of Post Keynesian Economics*, [online] 31(4), pp.707-727. Available at: <https://www.tandfonline.com/doi/abs/10.2753/PKE0160-3477310410?casa_token=2oJ7tdI22gwAAA:z470-tz13MiVJn7IAv_v3efmDtPokYuX3bc7INO M_gj6B5qQocq9jYUq8aeea6NcXSjo3-maSg> [Accessed 2 May 2022].
- Bolwig, S., Mark, M., Happel, M. and Brekke, A., 2019. Beyond animal feed?: The valorisation of brewers' spent grain. *Taylor & Francis*, [online] pp.107-126. Available at: <<https://orbit.dtu.dk/en/publications/beyond>>

- nd-animal-feed-the-valorisation-of-brewers-spent-grain> [Accessed 8 February 2022].
- Bonchek, M., 2016. Why the Problem with Learning Is Unlearning. *The Harvard Business Review*, [online] Available at: <<http://onlinelibrary>> [Accessed 8 February 2022].
- Borglund, T., De Geer, H., Sweet, S., Frostenson, M., Lerpold, L., Nordbrand, S., Sjöström, E. and Windell, K., 2017. *CSR and sustainable business*. 1st ed. Stockholm: Sanoma utbildning, pp.19-335.
- Boughzala, I. and de Vreede, G. (2015). Evaluating Team Collaboration Quality: The Development and Field Application of a Collaboration Maturity Model. *Journal of Management Information Systems*, 32(3), pp.129-157.
- Bradbury-Huang, H., 2010. What is good action research?. *Action Research*, [online] 8(1), pp.93-109. Available at: <http://file:///Users/famleborg/Downloads/Huang_2010_what%20is%20good%20action%20research.pdf> [Accessed 4 March 2022].
- Bransjeavtalen om reduksjon av matsvinn, 2022. *Bransjeavtalen om reduksjon av matsvinn. Hovedrapport 2020*. [online] Oslo: Bransjeavtalen om reduksjon av matsvinn. Available at: <<https://www.regjeringen.no/contentassets/6b7122f366433ca028c230b57605ae/no/pdfs/hovedrapport-2020-bransjeavtalen-om-reduksjon-av-matsvinn.pdf?fbclid=IwAR0yOm6ExaDeTTMMjINTM4p7accG-GBJiIQEbame3lkzvskoId8NGWaoz7E>> [Accessed 18 April 2022].
- Brewmaster at Macks Ølbryggeri AS, 2022. *Masters Project - Beer and the Future of Food* [Interview]. Conducted digitally over Zoom.com with E. Nagelhus and F. Leborg, 1. March 2022.
- Brewmaster at Sagene Bryggeri AS, 2022. *Masters Project - Beer and the Future of Food* [Interview]. Conducted digitally over Zoom.com with E. Nagelhus and F. Leborg, 10. February 2022.
- Burns, D., 2007. *Systematic Action Research - A strategy for whole system change*. Bristol: The Polity Press.
- Caradonna, J., 2014. *Sustainability - A History*. 3rd ed. New York: Oxford University Press US.
- Carlgren, L., Rauth, I. and Elmquist, M., 2016. Framing Design Thinking: The Concept in Idea and Enactment. *Creativity and Innovation Management*, [online] 25(1), pp.38-57. Available at: <<https://onlinelibrary.wiley.com/doi/10.1111/caim.12153>> [Accessed 7 April 2022].

- Catalyst 2030, 2022. *What is systems change – Catalyst 2030*. [online] Catalyst 2030. Available at: <<https://catalyst2030.net/what-is-systems-change/>> [Accessed 12 May 2022].
- Caulfield, J. and Brenner, E., 2019. Resolving complex community problems: Applying collective leadership and Kotter's change model to wicked problems within social system networks. *Nonprofit Management and Leadership*, [online] 30(3), pp.509-524. Available at: <https://onlinelibrary.wiley.com/doi/abs/10.1002/nml.21399?casa_token=99KuTF2kQRcAAAAA%3AAWRUVAOT5mhSjBpCz-Uab-h-0sY8JU7ImuVdG9GAe4LdFQnduOEKUsGuh7jzjHzLld5qzZSgYzteWnM> [Accessed 20 March 2022].
- CEO and founder for Waister AS, 2022. *Masters Project - Beer and the Future of Food* [Interview]. Conducted digitally over Zoom.com with E. Nagelhus and F. Leborg, 7. February 2022.
- CEO and founder of Attåtæring AS, 2022. *Masters Project - Beer and the Future of Food* [Interview]. Conducted digitally over Zoom.com with E. Nagelhus and F. Leborg, 10. February 2022.
- CEO and founder of Beer Flag, 2022. *Masters Project - Beer and the Future of Food* [Interview]. Conducted digitally over Zoom.com with E. Nagelhus and F. Leborg, 11. February 2022.
- CEO and founder of Bonsak AS, 2022. *Masters Project - Beer and the Future of Food* [Interview]. Conducted digitally over Zoom.com with E. Nagelhus and F. Leborg, 11. February 2022.
- CEO of Cernova Industri AS, 2022. *Masters Project - Beer and the Future of Food* [Interview]. Conducted digitally over Zoom.com with E. Nagelhus and F. Leborg, 17. February 2022.
- CFO of Arendals Bryggeri AS, 2022. *Masters Project - Beer and the Future of Food* [Interview]. Conducted digitally over Zoom.com with E. Nagelhus and F. Leborg, 14. February 2022.
- Chief of development at Ringnes AS, 2022. *Masters Project - Beer and the Future of Food* [Interview]. Conducted digitally over Zoom.com with E. Nagelhus and F. Leborg, 14. February 2022.
- Coghlan, D., 2001. Insider Action Research Projects. *Management Learning*, [online] 32(1), pp.49-60. Available at: <http://file:///Users/famleborg/Downloads/Coghlan_2001_Insider%20action%20research%20projects.pdf> [Accessed 4 March 2022].
- Coghlan, D. and Brydon-Miller, M., 2014. Journaling. In: *The SAGE Encyclopedia of*

Action Research, 1st ed. The SAGE Research Methods.

Coughlan, P. and Coughlan, D., 2002. Action research for operations management. *International Journal of Operations & Production Management*, [online] 22(2), pp.220-240. Available at: <http://file:///Users/famleborg/Downloads/coughlan%20and%20Coglan%202002_action%20research.pdf> [Accessed 4 March 2022].

Crane, A. and Matten, D., 2016. *Business ethics*. 4th ed. Oxford: Oxford University Press, pp.1-546.

Cypress, B., 2017. Rigor or Reliability and Validity in Qualitative Research. *Dimensions of Critical Care Nursing*, [online] 36(4), pp.253-263. Available at: <https://journals.lww.com/dccjournal/fulltext/2017/07000/rigor_or_reliability_and_validity_in_qualitative.6.aspx> [Accessed 3 April 2022].

Daemrich, A., 2017. Invention, Innovation Systems, and the Fourth Industrial Revolution. *Technology & Innovation*, [online] 18(4), pp.257-265. Available at: <<https://www.ingentaconnect.com/content/nai/ti/2017/00000018/00000004/art00005#>> [Accessed 8 May 2022].

Davelaar, D., 2021. Transformation for sustainability: a deep leverage points

approach. *Sustainability Science*, [online] 16(3), pp.727-747. Available at: <<https://link.springer.com/article/10.1007/s11625-020-00872-0>> [Accessed 6 May 2022].

Dentoni, D., Waddell, S. and Waddock, S., 2017. Pathways of transformation in global food and agricultural systems: implications from a large systems change theory perspective. *Current Opinion in Environmental Sustainability*, [online] 29, pp.8-13. Available at:

<https://www.sciencedirect.com/science/article/pii/S1877343517302233?casa_token=hMO-p1S8WlgAAAAA:6s_fgHFegYu29xoPxneBAbtooQJgJJo4A0Lh7II5WnY2rFo5ACzIy24sOSFs5JK-vAtUB-8> [Accessed 9 May 2022].

Department of Chemical Engineering, Lund University, 2004. *Introduction to Systems Thinking and Casual Loop Diagrams*. [online] Lund: Lund University. Available at: <https://www.researchgate.net/profile/Horaldur-Haraldsson/publication/258261003_Introduction_to_system_thinking_and_causal_loop_diagrams/links/5bceed6458515f7d9d01e81/Introduction-to-system-thinking-and-causal-loop-diagrams.pdf> [Accessed 17 April 2022].

- Desa, G. and Koch, J., 2014. Scaling Social Impact: Building Sustainable Social Ventures at the Base-of-the-Pyramid. *Journal of Social Entrepreneurship*, [online] 5(2), pp.146-174. Available at: <<https://doi.org/10.1080/19420676.2013.871325>> [Accessed 1 March 2022].
- Director of Analysis and Policy at Norkorn - NHO Food and Drinks (FoodDrink Norway), 2022. *Masters Project - Beer and the Future of Food* [Interview]. Conducted digitally over Zoom.com with E. Nagelhus and F. Leborg, 22. February 2022.
- du Plessis, C., 2012. Towards a regenerative paradigm for the built environment. *Building Research & Information*, [online] 40(1), pp.7-22. Available at: <<https://doi.org/10.1080/09613218.2012.628548>> [Accessed 11 April 2022].
- Elrod, P. and Tippett, D. (1999). An Empirical Study of the Relationship Between Team Performance and Team Maturity. *Engineering Management Journal*, 11(1), pp.7-14.
- Environment Ministry, 2022. *Svalbard Environmental Protection Act*. [online] Government.no. Available at: <<https://www.regjeringen.no/en/dokumenter/svalbard-environmental-protection-act/id173945/>> [Accessed 15 May 2022].
- Estévez, A., Padrell, L., Iñarra, B., Orive, M. and Martín, D., 2021. Brewery by-products (yeast and spent grain) as protein sources in gilthead seabream (*Sparus aurata*) feeds. *Aquaculture*, [online] 543, p.736921. Available at: <<https://doi.org/10.1016/j.aquaculture.2021.736921>> [Accessed 30 March 2022].
- Evans, D., 2002. Systematic reviews of interpretive research: interpretive data synthesis of processed data. *Australian Journal of Advanced Nursing*, [online] 20(2), pp.22-6. Available at: <<https://search.informit.org/doi/abs/10.3316/ielapa.405497388325103>> [Accessed 15 May 2022].
- Falkner, R., 2008. *Business Power and Conflict in International Environmental Politics*. 1st ed. London: Palgrave MacMillan.
- Fao.org. 2022. *FAO Food Price Index | World Food Situation | Food and Agriculture Organization of the United Nations*. [online] Available at: <<https://www.fao.org/worldfoodsituation/foodpricesindex/en/>> [Accessed 18 April 2022].
- Farmer from Ner-Bartnes gård, 2022. *Masters Project - Beer and the Future of Food* [Interview]. Conducted digitally over Zoom.com with E. Nagelhus and F. Leborg, 8. February 2022.
- Fletcher, A., MacPhee, M. and Dickson, G., 2015. Doing Participatory Action Research in a Multicase Study. *International Journal of*

Qualitative Methods, 14(5), p.160940691562140.

Fontaine, M., 2013. Corporate Social Responsibility and Sustainability: The New Bottom Line?. *International Journal of Business and Social Science*, [online] 4(4), pp.110-120. Available at: <<http://www.mktgsensei.com/AMAE/Visi on%20and%20Mission/Corproate%20Socia l%20Responsibility%20Fontaine.pdf>> [Accessed 15 May 2022].

Food and Agriculture Organization of the United Nations. 2020. *Sustainable Food and Agriculture - Land use in agriculture by the numbers*. [online] Available at: <<https://www.fao.org/sustainability/news/detail/en/c/1274219/>> [Accessed 10 February 2022].

Foster-Fishman, P., Nowell, B. and Yang, H., 2007. Putting the system back into systems change: a framework for understanding and changing organizational and community systems. *American Journal of Community Psychology*, [online] 39(3-4), pp.197-215. Available at: <<https://link.springer.com/article/10.1007/s10464-007-9109-0>> [Accessed 5 May 2022].

Framtiden i Våre Hender, 2014. *En kartlegging av soyaforbruket i norske landbruk og oppdrettsnaering.. Godt Brasil*. [online] oslo: Framtiden i våre hender. Available at:

<<https://www.framtiden.no/aktuelle-rapporter/743-godt-brasiliansk-en-kartlegging-av-soyaforbruket-i-norsk-landbruk-og-oppdrettsnaering/file.html>> [Accessed 14 February 2022].

Fullerton, J. (2015). *Regenerate Capitalism - How Universal Principles And Patterns Will Shape Our New Economy*. Capital Institute - The Future of Finance.

Galea, M., 2014. The Relationship of Personality, Spirituality and Posttraumatic Growth to Subjective Wellbeing. *OALib*, [online] 01(08), pp.1-10. Available at: <[https://www.scirp.org/\(S\(351jmbntvnsjt1aadkozje\)\)/reference/referencespapers.aspx?referenceid=1710224](https://www.scirp.org/(S(351jmbntvnsjt1aadkozje))/reference/referencespapers.aspx?referenceid=1710224)> [Accessed 7 April 2022].

Geels, F. (2019). Socio-technical transitions to sustainability: a review of criticisms and elaborations of the Multi-Level Perspective. *Current Opinion in Environmental Sustainability*, [online] 39, pp.187-201. Available at: <<https://www.sciencedirect.com/science/article/abs/pii/S1877343519300375>> [Accessed 25 November 2021].

Geissdoerfer, M., Savaget, P., Bocken, N. and Hultink, E., 2017. The Circular Economy – A new sustainability paradigm?. *Journal of Cleaner Production*, [online] 143, pp.757-768. Available at: <https://www.sciencedirect.com/science/article/pii/S0959652616321023?casa_token=

qEGUB6NqiHUA:0tf9Z8CIP4eevO
gP5pcIZmF1TlvirCffcyjMPiAKpW1nGK
GIkxcYCB2bsgi8R2YsFmfbwwZ#bib95>
[Accessed 9 May 2022].

Gharajedaghi, J. and Ackoff, R., 1984.
Mechanisms, organisms and social systems.
Strategic Management Journal, [online] 5(3),
pp.289-300. Available at:
<<https://onlinelibrary.wiley.com/doi/abs/10.1002/smj.4250050308>> [Accessed 2 March
2022].

Giacalone, R. and Jurkiewicz, C., 2003.
*Handbook of workplace spirituality and
organizational performance*. 1st ed. Taylor and
Francis Ltd.

Giacalone, R. and Jurkiewicz, C., 2010.
*Handbook of Workplace Spirituality and
Organizational Performance*. 2nd ed. New York:
Routledge.

Gibbons, L., 2020. Regenerative—The New
Sustainable?. *Sustainability*, [online] 12(13),
p.5483. Available at:
<<https://www.mdpi.com/2071-1050/12/13/5483>> [Accessed 10 February
2022].

Gibbons, L., Cloutier, S., Coseo, P. and
Barakat, A., 2018. Regenerative Development
as an Integrative Paradigm and Methodology
for Landscape Sustainability. *Sustainability*,
[online] 10(6), p.1910. Available at:

<<https://www.mdpi.com/2071-1050/10/6/1910>> [Accessed 9 April 2022].

Gleiss, A., Oberbauer, R. and Heinze, G.,
2017. An unjustified benefit: immortal time
bias in the analysis of time-dependent events.
Transplant International, [online] 31(2), pp.125-
130. Available at:
<https://onlinelibrary.wiley.com/doi/full/10.1111/tri.13081?casa_token=C8YOea3xbggAAAAA%3AdhCcL3YMDddACDg7euQ3FA3NITcH9hYJLdDEGIFnZ05ZhMZpFvzPcR3QFHbMB9OIAu4rPVCHFijw>
[Accessed 10 May 2022].

González-Márquez, I. and Toledo, V., 2020.
Sustainability Science: A Paradigm in Crisis?.
Sustainability, [online] 12(7), p.2802. Available
at: <<https://www.mdpi.com/2071-1050/12/7/2802>> [Accessed 10 April 2022].

Gorissen, L., Vrancken, K. and Manshoven,
S. (2016). Transition Thinking and Business
Model Innovation—Towards a
Transformative Business Model and New
Role for the Reuse Centers of Limburg,
Belgium. *Sustainability*, 8(2), p.112.

Gowdy, J., 2020. Our hunter-gatherer future:
Climate change, agriculture and
uncivilization. *Futures*, [online] 115, p.102488.
Available at:
<<https://www.sciencedirect.com/science/article/pii/S0016328719303507>> [Accessed 5
April 2022].

- Gustavsen, B., 2008. Action research, practical challenges and the formation of theory. *Action Research*, [online] 6(4), pp.421-437. Available at: <http://file:///Users/famleborg/Downloads/Gustavsen_2008_Action%20research_formation%20of%20theory.pdf> [Accessed 4 March 2022].
- Hahn, T. and Tampe, M., 2020. Strategies for regenerative business. *Strategic Organization*, [online] 19(3), pp.456-477. Available at: <<https://journals.sagepub.com/doi/abs/10.1177/1476127020979228>> [Accessed 9 May 2022].
- Happel, M., Bolwig, S. and Mark, M., 2017. Sustainability Strategies in the Nordic Brewing Industry with a Focus on Spent Grain. *18th European Roundtable on Sustainable Consumption and Production Conference (ERSCP 2017)*, [online] Available at: <https://www.researchgate.net/profile/Michael-Mark-3/publication/319905887_Sustainability_Strategies_in_the_Nordic_Brewing_Industry_with_a_Focus_on_Spent_Grain/links/5a1ebbf7aca272cbfbc06b60/Sustainability-Strategies-in-the-Nordic-Brewing-Industry-with-a-Focus-on-Spent-Grain.pdf> [Accessed 9 February 2022].
- Hardy, J., 2003. *Climate change - Causes, Effects and Solutions*. Chichester: J. Wiley.
- Harris, H., 2001. Content Analysis of Secondary Data: A Study of Courage in Managerial Decision Making. *Journal of Business Ethics volume*, [online] (34), pp.191-208. Available at: <<https://link.springer.com/article/10.1023/A:1012534014727>> [Accessed 15 May 2022].
- Holstad, M., 2022. *Tidenes høyeste strompris i 4. kvartal*. [online] SSB. Available at: <<https://www.ssb.no/energi-og-industri/energi/statistikk/elektrisitetspriser/artikler/tidenes-hoyeste-strompris-i-4.kvartal>> [Accessed 18 April 2022].
- Holt-Giménez, E., Shattuck, A., Altieri, M., Herren, H. and Gliessman, S., 2012. We Already Grow Enough Food for 10 Billion People ... and Still Can't End Hunger. *Journal of Sustainable Agriculture*, [online] 36(6), pp.595-598. Available at: <<https://doi.org/10.1080/10440046.2012.695331>> [Accessed 11 April 2022].
- Horn, C., 2016. *Introduction to Industrial Ecology and Industrial Metabolism*.
- Huanga, L. and Lua, F., 2022. The Cost of Russian Sanctions on the Global Equity Markets. [online] Available at: <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4060927> [Accessed 18 April 2022].

- IPCC, 2019: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. In press.
- Ismailova, N., Eshov, M. and Balbaa, M., 2022. The Impacts of Russian-Ukrainian War on the Global Economy. *Tashkent State University of Economics*, [online] Available at: <https://www.researchgate.net/profile/Muhammad-Balbaa/publication/360074361_The_Impacts_of_Russian-Ukrainian_War_on_the_Global_Economy/links/6260411cbca601538b5a325f/The-Impacts-of-Russian-Ukrainian-War-on-the-Global-Economy.pdf> [Accessed 11 May 2022].
- James, K., Randall, N. and Haddaway, N., 2016. A methodology for systematic mapping in environmental sciences. *Environmental Evidence*, [online] 5(1). Available at: <<https://environmentalevidencejournal.biomedcentral.com/articles/10.1186/s13750-016-0059-6>> [Accessed 4 May 2022].
- Jensen, D., 2006. *Endgame - The Problem of Civilization*. 1st ed. New York: Seven Stories Press, p.85.
- Johnson, L., 2021. What is a System?. [online] Available at: <<https://repositories.lib.utexas.edu/bitstream/handle/2152/111154/Johnsonpaper.pdf?sequence=2>> [Accessed 12 May 2022].
- Jones, D., Allen, S., Cole, S. and Milligan, S., 2022. *Building System Change Through Public and Private Partnerships*. Cuyahoga County Early Childhood Initiative Evaluation: Interim Report. [online] Available at: <https://www.researchgate.net/profile/Sharon-Milligan/publication/265280945_Chapter_3_Building_System_Change_Through_Public_and_Private_Partnerships/links/55ccfd8e08aceaab209b4e02/Chapter-3-Building-System-Change-Through-Public-and-Private-Partnerships.pdf> [Accessed 12 May 2022].
- Jones, N., Ross, H., Lynam, T., Perez, P. and Leitch, A., 2011. Mental Models: An Interdisciplinary Synthesis of Theory and Methods. *Ecology and Society*, [online] 16(1). Available at: <https://www.jstor.org/stable/pdf/26268859.pdf?refreqid=excelsior%3A53c8ed8ef91d47be0fe7a36a9a22a83c&ab_segments=&origin=>> [Accessed 8 February 2022].

- Kay, J., 2008. The Ecosystem approach: complexity, uncertainty, and managing for sustainability. *Choice Reviews Online*, [online] 47(01), pp.47-0250-47-0250. Available at: <<http://www.jstor.org/stable/10.7312/walt13250>> [Accessed 10 April 2022].
- Kennedy-Lewis, B., 2012. When a Teacher Becomes a Researcher: Using Self-Narrative to Define One's Role as Participant Observer. *Theory Into Practice*, [online] 51(2), pp.107-113. Available at: <<https://doi.org/10.1080/00405841.2012.662865>> [Accessed 5 May 2022].
- Kirkpatrick, P., 2013. Weak Vs Strong Sustainability. *The Sustainable Business toolkit*, [online] Available at: <<https://www.sustainablebusiness toolkit.com/weak-vs-strong-sustainability-2/>> [Accessed 12 May 2022].
- Knudsen, S., 2022. *Mentor Meeting*.
- Kopnina, H., Washington, H., Taylor, B. and J Piccolo, J., 2018. Anthropocentrism: More than Just a Misunderstood Problem. *Journal of Agricultural and Environmental Ethics*, [online] 31(1), pp.109-127. Available at: <<https://link.springer.com/article/10.1007/s10806-018-9711-1>> [Accessed 5 May 2022].
- Kosmol, L. and Otto, L. (2020). Implementation Barriers of Industrial Symbiosis: A Systematic Review. *d Hawaii International Conference on System Sciences*, [online] Available at: <https://hdl.handle.net/10125/64483_978-0-9981331-3-3> [Accessed 25 November 2021].
- Krueger, R. and Casey, M., 2022. *Focus Groups: A Practical Guide for Applied Research*. 5th ed. Thousand Oak: SAGE Publishing.
- Lane, D., Munro, E. and Husemann, E., 2016. Blending systems thinking approaches for organisational analysis: Reviewing child protection in England. *European Journal of Operational Research*, [online] 251(2), pp.613-623. Available at: <<https://www.sciencedirect.com/science/article/pii/S0377221715009674>> [Accessed 5 March 2022].
- Lang, D., Schomerus, T., Newig, J., Leventon, J., Fischer, J., Abson, D., Vilsmaier, U., Wehrden, H., Abernethy, P., Ives, C. and Jager, N., 2017. *Leverage points for sustainability transformation*. [image] Available at: <<https://link.springer.com/content/pdf/10.1007/s13280-016-0800-y.pdf>> [Accessed 14 May 2022].
- Larsen Sandst a, B., 2020. *Nordmenns forbruk nest b yest i Europa*. [online] ssb.no. Available at: <[https://www.ssb.no/priser-og-prisindekser/artikler-og-publikasjoner/nordmenns-forbruk-nest-](https://www.ssb.no/priser-og-prisindekser/artikler-og-publikasjoner/nordmenns-forbruk-nest)

hoyest-i-europa> [Accessed 18 January 2022].

Laszlo, C., Waddock, S., Maheshwari, A., Nigri, G. and Storberg-Walker, J., 2021. Quantum Worldviews: How science and spirituality are converging to transform consciousness for meaningful solutions to wicked problems. *Humanistic Management Journal*, [online] 6(3), pp.293-311. Available at: <<https://link.springer.com/article/10.1007/s41463-021-00114-0>> [Accessed 8 February 2022].

Laszlo, C., Waddock, S., Maheshwari, A., Nigri, G. and Storberg-Walker, J., 2021. Quantum Worldviews: How science and spirituality are converging to transform consciousness for meaningful solutions to wicked problems. *Humanistic Management Journal*, [online] 6(3), pp.293-311. Available at: <<https://link.springer.com/article/10.1007/s41463-021-00114-0#ref-CR94>> [Accessed 2 April 2022].

Laszlo, E., 1972. *Introduction to Systems Philosophy - Toward a New Paradigm of Contemporary Thought*. 1st ed. Milton: Taylor & Francis Group, pp.1-356.

Lenton, T., Rockström, J., Gaffney, O., Rahmstorf, S., Richardson, K., Steffen, W. and Schellnhuber, H., 2019. Climate tipping points — too risky to bet against. *Nature*, [online] 575(7784), pp.592-595. Available at: <<https://www.researchgate.net/publication>

/337583286_Climate_tipping_points_-_too_risky_to_bet_against> [Accessed 10 April 2022].

Levin, K., Cashore, B., Bernstein, S. and Auld, G., 2012. Overcoming the tragedy of super wicked problems: constraining our future selves to ameliorate global climate change. *Policy Sciences*, [online] 45(2), pp.123-152. Available at: <<https://link.springer.com/article/10.1007/s11077-012-9151-0>> [Accessed 20 March 2022].

Mahlman, J., 1997. Uncertainties in Projections of Human-Caused Climate Warming. *Science*, [online] 278(5342), pp.1416-1417. Available at: <<https://www.science.org/doi/10.1126/science.278.5342.1416>> [Accessed 14 May 2022].

Mahmud, A. and Jahan, S., n.d. What Is Capitalism? - Free markets may not be perfect but they are probably the best way to organize an economy. *Finance & Development*, [online] Available at: <https://www.imf.org/external/pubs/ft/fandd/basics/2_capitalism.htm> [Accessed 9 May 2022].

Massoud, H. and Ayoubi, R., 2012. Marketing motivations of CSR: The case of the Syrian private sector. *European Journal of Economics, Finance and Administrative Sciences*, [online] 1(52), pp.179-194. Available at:

<<http://www.eurojournals.com/EJEFAS.htm>> [Accessed 25 April 2022].

Mbah, R. and Wasum, D., 2022. Russian-Ukraine 2022 War: A Review of the Economic Impact of Russian-Ukraine Crisis on the USA, UK, Canada, and Europe. *Advances in Social Sciences Research Journal*, [online] 9(3), pp.144-153. Available at: <https://www.researchgate.net/profile/Ruth-Endam-Mbah/publication/359512955_Russian-Ukraine_2022_War_A_Review_of_the_Economic_Impact_of_Russian-Ukraine_Crisis_on_the_USA/links/6241fcd21077329f2dd2c3d/Russian-Ukraine-2022-War-A-Review-of-the-Economic-Impact-of-Russian-Ukraine-Crisis-on-the-USA.pdf> [Accessed 6 May 2022].

McPherson, M., 2002. *Figure. 1-Spiral of Action Research Cycles [12]. Action research results from spiral research cycles, starting with a process of identifying a problem area-a.* [image] Available at: <https://www.researchgate.net/publication/241014356_No_Lectures_On-Campus_Can_eLearning_Provide_a_Better_Learning_Experience/figures?lo=1> [Accessed 15 May 2022].

Meadows, D., 1999. Leverage Points: Places to Intervene in a System. *The Sustainability Institute*, [online] Available at: <[https://donellameadows.org/wp-](https://donellameadows.org/wp-content/userfiles/Leverage_Points.pdf)

[content/userfiles/Leverage_Points.pdf](https://donellameadows.org/wp-content/userfiles/Leverage_Points.pdf)> [Accessed 11 April 2022].

Meadows, D., 2008. Thinking in Systems - A Primer. *The System Lens*, [online] Available at: <<http://radicalteacher.com/uploads/MeadowsIntroOne.pdf>> [Accessed 9 February 2022].

Melander, L., 2017. Achieving Sustainable Development by Collaborating in Green Product Innovation. *Business Strategy and the Environment*, [online] 26(8), pp.1095-1109. Available at: <https://onlinelibrary.wiley.com/doi/abs/10.1002/bse.1970?casa_token=ftee9PHVioAAAAA%3AHea3PFbGXDWFiHg1iU6IFLKdpbrrORi8D7Ay8-P0djp_rHJCO7zoisMenPdfTWV7inGe5-04w0QU> [Accessed 9 May 2022].

Melrose, M., 2001. Maximizing the Rigor of Action Research: Why Would You Want To? How Could You?. *Field Methods*, [online] 13(2), pp.160-180. Available at: <http://file:///Users/famleborg/Downloads/Melrose_rigor.pdf> [Accessed 4 March 2022].

Mentor meetings:

Merriam-Webster. 2022. *Merriam-Webster - System definition.* [online] Available at: <<https://www.merriam-webster.com/dictionary/system>> [Accessed 12 May 2022].

- Miller, T., Wiek, A., Sarewitz, D., Robinson, J., Olsson, L., Kriebel, D. and Loorbach, D., 2013. The future of sustainability science: a solutions-oriented research agenda. *Sustainability Science*, [online] 9(2), pp.239-246. Available at: <<https://doi.org/10.1007/s11625-013-0224-6>> [Accessed 11 April 2022].
- Mohan, M., 2020. Use of critical reflection as a research method: A case of research-induced distress? Malu Mohan. *Indian Journal of Medical Ethics*, [online] 05(01), pp.19-20. Available at: <<https://pubmed.ncbi.nlm.nih.gov/32103803/>> [Accessed 5 May 2022].
- National Research Council, 1999. Our Common Journey. A Transition toward Sustainability. *International Journal of Social Economics*, [online] 29(4), pp.335-340. Available at: <<https://www.jstor.org/stable/43623329>> [Accessed 11 April 2022].
- Neves, A., Godina, R., G. Azevedo, S., Pimentel, C. and C.O. Matias, J. (2019). The Potential of Industrial Symbiosis: Case Analysis and Main Drivers and Barriers to Its Implementation. *Sustainability*, 11(24), p.7095.
- Nicholson, C., Stephens, E., Jones, A., Kopainsky, B., Parsons, D. and Garrett, J., 2019. Setting priorities to address the research gaps between agricultural systems analysis and food security outcomes in low- and middle-income countries. *CGLAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)*, [online] 255. Available at: <<http://www.ccafs.cgiar.org>> [Accessed 21 April 2022].
- Nocente, F., Taddei, F., Galassi, E. and Gazza, L., 2019. Upcycling of brewers' spent grain by production of dry pasta with higher nutritional potential. *LWT*, [online] 114, p.108421. Available at: <https://www.sciencedirect.com/science/article/abs/pii/S0023643819307637?casa_token=Fu-pI76jDnAAAAA:hFToK_SKznSjfTE5JIyB-6N3gVfEM8z3s4WCrfc7s9oPFJ8hJO-6z5bS6ioH4eSssLX14Yelow> [Accessed 10 February 2022].
- NOFIMA, 2016. *Kartlegging av restråstoff fra jordbruket*. [online] Available at: <<https://nofima.brage.unit.no/nofima-xmlui/bitstream/handle/11250/2428846/Rapport%2B67-2016.pdf?sequence=1&isAllowed=y>> [Accessed 20 March 2022].
- Nordby, M., 2016. *Intervensjonsforskning - aksjonsforskning eller design-basert klasseromsforskning?*.
- Paquin, R. and Howard-Grenville, J. (2012). The Evolution of Facilitated Industrial Symbiosis. *Journal of Industrial Ecology*, 16(1), pp.83-93.

Peters, B., 2017. What is so wicked about wicked problems? A conceptual analysis and a research program. *Policy and Society*, [online] 36(3), pp.385-396. Available at: <<https://doi.org/10.1080/14494035.2017.1361633>> [Accessed 11 April 2022].

Pilot-project group: Cernova, Arendal and Felleskjøpet, 2022. Milestensmøte [Milestone meeting 2]. digitally over Zoom.com with E. Nagelhus and F. Leborg, 5. May 2022.

Pilot-project group: Cernova, Arendal and Felleskjøpet, 2022. Oppstartsmøte [Project-kick off meeting]. digitally over Zoom.com with E. Nagelhus and F. Leborg, 8. March 2022.

Pilot-project group: Cernova, Arendal and Felleskjøpet, 2022. Oppstartsmøte [Milestone meeting 1]. digitally over Zoom.com with E. Nagelhus and F. Leborg, 5. April 2022.

Plotkin, H., 1997. *Darwin machines and the nature of knowledge*. Cambridge, Mass.: Harvard University Press.

Porter, S., 2007. Validity, trustworthiness and rigour: reasserting realism in qualitative research. *Journal of Advanced Nursing*, [online] 60(1), pp.79-86. Available at: <<http://www.aral.com.au/resources/rigour3.html>> [Accessed 4 May 2022].

Raufflet, E., Baba, S., Perras, C. and Delannon, N., n.d. *Social License*. [online] Encyclopedia of Corporate Social Responsibility. Available at: <https://link.springer.com/referenceworkentry/10.1007/978-3-642-28036-8_77> [Accessed 28 April 2022].

Reason, P. and Heron, J., 2022. The Practice of Co-operative Inquiry: Research with rather than on people. *Handbook of Action Research, first edition*, [online] pp.179-188. Available at: <https://www.academia.edu/33809173/The_Practice_of_Co-operative_Inquiry_Research_with_rather_than_on_people> [Accessed 15 May 2022].

References (Harvard)

Regjeringen, 2022. *Sandra Borch iverksetter utredning av beredskapslagring av korn*. [online] Regjeringen.no. Available at: <<https://www.regjeringen.no/no/aktuelt/sandra-borch-iverksetter-utredning-av-beredskapslagring-av-korn/id2903980/>> [Accessed 11 May 2022].

Reigeluth, C. and Joseph, R., 2010. The Systemic Change Process in Education: A Conceptual Framework. *Contemporary Educational Technology*, [online] 1(2). Available at: <https://www.researchgate.net/publication/291827633_The_Systemic_Change_Process_in_Education_A_Conceptual_Framework_149> [Accessed 11 May 2022].

Researcher and economist at Danmarks Tekniske Universitet (DTU) and NIFU, 2022. *Masters Project - Beer and the Future of Food* [Interview]. Conducted digitally over Zoom.com with E. Nagelhus and F. Leborg, 8. February 2022. *Future of Food [Interview]*.

Researcher and Professor bioprocesses at Norwegian University of Life Sciences (NMBU), 2022. *Masters Project - Beer and the Future of Food* [Interview]. Conducted digitally over Zoom.com with E. Nagelhus and F. Leborg, 16. February 2022.

Reuterdaahl, A., 2012. *Rekordimport av matkorn*. [online] NRK. Available at: <<https://www.nrk.no/dokumentar/rekordimport-av-matkorn-1.8283586>> [Accessed 11 April 2022].

Richard Bawden's Lab, 2019. *Figure 2.4 Food systems map that shows how multiple subsystems interact* (. [image] Available at: <https://www.researchgate.net/profile/Wei-Zhang-707/publication/331375280/figure/fig4/AS:730889449390080@1551269032210/Food-systems-map-that-shows-how-multiple-subsystems-interact-Source-adapted-from-the_W640.jpg> [Accessed 14 May 2022].

Ridder, M., 2022. *Norway: agricultural area used for barley production 2008-2018* | Statista. [online] Statista. Available at: <<https://www.statista.com/statistics/988397/agricultural-area-used-for-barley->

[production-in-norway/](https://www.statista.com/statistics/988397/agricultural-area-used-for-barley-production-in-norway/)> [Accessed 10 February 2022].

Rittel, H. and Webber, M., 1973. Dilemmas in a general theory of planning. *Policy Sciences*, [online] 4(2), pp.155-169. Available at: <<https://link.springer.com/article/10.1007/bf01405730>> [Accessed 9 February 2022].

Rittel, H. and Webber, M., 1973. Dilemmas in a general theory of planning. *Policy Sciences*, [online] 4(2), pp.155-169. Available at: <<http://www.jstor.org/stable/4531523> .> [Accessed 11 April 2022].

Ruggie, J., 2017. Multinationals as global institution: Power, authority and relative autonomy. *Regulation & Governance*, [online] 12(3), pp.317-333. Available at: <<https://onlinelibrary.wiley.com/doi/full/10.1111/rego.12154>> [Accessed 7 May 2022].

Sachdeva, S., Jordan, J. and Mazar, N., 2015. Green consumerism: moral motivations to a sustainable future. *Current Opinion in Psychology*, [online] 6, pp.60-65. Available at: <https://www.sciencedirect.com/science/article/pii/S2352250X15001347?casa_token=T-5HI0Y6TKwAAAAA:FH-IJSPk0_ikiX0HG6_REJw195OEEed2PBIULVGue0KY5lgLAwrSmeDVFuKM7BtR1meWnbbg> [Accessed 3 May 2022].

Sauro, J., 2015. *4 Types of Observational Research – MeasuringU*. [online] Measuringu.com. Available at:

- <<https://measuringu.com/observation-role/>> [Accessed 14 May 2022].
- Schwartz, M. and Carroll, A., 2003. Corporate Social Responsibility: A Three-Domain Approach. *Business Ethics Quarterly*, [online] 13(4), pp.503-530. Available at: <<https://doi.org/10.5840/beq200313435>> [Accessed 6 April 2022].
- Scroggs, J., 1966. The paradoxical nature of man. *Journal of Religion and Health*, [online] 5(1), pp.17-26. Available at: <<https://www.jstor.org/stable/27504766?seq=1>> [Accessed 3 May 2022].
- Sekaran, U. and Bougie, R., 2020. *Research Methods for Business - A Skill Building Approach*. 8th ed. Glasgow: John Wiley & Sons, p.106.
- Shahbandeh, M., 2022. *World barley production 2021/2022 | Statista*. [online] Statista. Available at: <<https://www.statista.com/statistics/271973/world-barley-production-since-2008/>> [Accessed 10 February 2022].
- SINTEF, 2020. *Studie av potensialet for verdiskaping og sysselsetting av sirkulærøkonomiske tiltak - Utvalgte tiltak og case*. Teknologi for et bedre samfunn. [online] Available at: <https://sintef.brage.unit.no/sintef-xmlui/bitstream/handle/11250/2690052/2020_00958%2bStudie%2bav%2bpotensialet%2bfor%2bverdiskaping%2bog%2bsysselsetting%2bav%2bsirkul%25C3%25A6r%25C3%25B8konomiske%2btiltak.pdf?sequence=1&isAllowed=y> [Accessed 18 January 2022].
- Smith, R., 2010. Beyond growth or beyond capitalism?. *Real-world Economics Review*, [online] (53), pp.28-42. Available at: <<http://paecon.net/PAERReview/issue53/Smith53.pdf>> [Accessed 9 May 2022].
- Smith, V., 1998. The Two Faces of Adam Smith. *Southern Economic Journal*, [online] 65(1), p.1. Available at: <<https://doi.org/10.1002/j.2325-8012.1998.tb00125.x>> [Accessed 8 May 2022].
- Snijders, T., 1992. Estimation On the Basis of Snowball Samples: How To Weight?. *Bulletin of Sociological Methodology/Bulletin de Méthodologie Sociologique*, [online] 36(1), pp.59-70. Available at: <<https://journals.sagepub.com/doi/abs/10.1177/075910639203600104>> [Accessed 15 May 2022].
- Södergren, K. and Palm, J. (2021). The role of local governments in overcoming barriers to industrial symbiosis. *Cleaner Environmental Systems*, 2, p.100014.
- Solberg, L., 2007. Improving Medical Practice: A Conceptual Framework. *The Annals of Family Medicine*, [online] 5(3), pp.251-256. Available at: <<https://www.annfammed.org/content/5/3/251.short>> [Accessed 6 May 2022].

Special adviser and subject manager for bioeconomics at Innovation Norway, 2022. *Masters Project - Beer and the Future of Food* [Interview]. Conducted digitally over Zoom.com with E. Nagelhus and F. Leborg, 14. February 2022.

Special adviser for bioeconomics at The Research Council of Norway, 2022. *Masters Project - Beer and the Future of Food* [Interview]. Conducted digitally over Zoom.com with E. Nagelhus and F. Leborg, 16. February 2022.

Specialist of Raw Milk at Tine SA, 2022. *Masters Project - Beer and the Future of Food* [Interview]. Conducted digitally over Zoom.com with E. Nagelhus and F. Leborg, 10. February 2022.

SSB, 2022. *Utenrikshandel med varer*. [online] Statistics Norway - SSB. Available at: <<https://www.ssb.no/utenriksokonomi/utenrikshandel/statistikk/utenrikshandel-med-varer>> [Accessed 11 May 2022].

Stacey, M., 2007. ACTION LEARNING: ADDRESSING TODAY'S BUSINESS CHALLENGES WHILE DEVELOPING LEADERS FOR TOMORROW. *Fresh Perspectives on Leadership Development*, [online] Available at: <<http://www.williamrtorbert.com/wp-content/uploads/2012/06/Fresh-Perspective-on-Action-Learning-21.pdf>> [Accessed 15 May 2022].

Stroh, D., 2015. *Systems Thinking for Social Change - A Practical Guide to Solving Complex Problems, Avoiding Unintended Consequences, and Achieving Lasting Results*. 1st ed. White River Junction, United States: Chelsea Green Publishing Co.

Stroh, D., 2022. *Mentor Meeting*.

Tamarack Institute, n.d. *Single, Double and Triple Loop Learning*. [online] Tamarack Institute. Available at: <<https://www.tamarackcommunity.ca/hubfs/Events/Multi-Day%20Events/Community%20Change%20Institute%20-%20CCI/2017%20CCI%20Vancouver/Resources/Tool%20-%20Single%20Double%20Triple%20Loop%20Learning.pdf>> [Accessed 12 May 2022].

Teixeira-Poit, S., Smith, L., Ashok, M., Dy, S. and Wines, R., 2014. Contextual Frameworks for Research on the Implementation of Complex System Interventions. *Methods Research Reports*, [online] Available at: <<https://www.ncbi.nlm.nih.gov/sites/books/NBK196199/>> [Accessed 11 May 2022].

Termeer, C., Dewulf, A. and Biesbroek, R., 2019. A critical assessment of the wicked problem concept: relevance and usefulness for policy science and practice. *Policy and Society*, [online] 38(2), pp.167-179. Available at: <<https://academic.oup.com/policyandsocie>

ty/article/38/2/167/6407923?login=false>
[Accessed 8 May 2022].

Trainer, T., 1990. A rejection of the Brundtland Report. *University of New South Wales*, [online] (77), pp.71-84. Available at: <<https://www.cabdirect.org/cabdirect/abstract/19901884018>> [Accessed 9 May 2022].

United Nations, 2011. *Guiding Principles of Business and Human Rights*. Implementing the United Nations "Protect, Respect and Remedy" Framework. [online] New York & Geneva: United Nations Human Rights Office of the High Commissioner. Available at: <https://www.ohchr.org/sites/default/files/Documents/Publications/GuidingPrinciplesBusinessHR_EN.pdf> [Accessed 16 April 2022].

Urdan, T., Maehr, M., Hruda, L., Anderman, J., Midgley, C., Anderman, L., Freeman, K., Gheen, M., Kaplan, A., Kumar, R., Middleton, M., Nelson, J. and Roeser, R., 2000. Manual for the patterns of adaptive learning scales. *University of Michigan*, [online] Available at: <https://d1wqtxts1xzle7.cloudfront.net/3479746/pals_2000_v12word97-with-cover-page-v2.pdf?Expires=1652126825&Signature=LbzkhS-ORGrsbzh6S7JB1e1RsAYNCrQTCrGLvEIRnzbWBg6zStKO23EiSTWeREmf~CdnqtNQW5CTc73NsvM9FA6zeM1V2>

O-2pC3NffOCaFjfmv-cwYjtu-OmClqVeHdBfYC2FE~oHME5yNOUP6GPmd4QgjDh4VuG7U0SGpMDWrlhddT-dd4FI4YKIFPfrVykDQ--3mFiZBHECQgDLHyvUxUGv9YVmfXeDsn0pXKaT4Lrk~IKI9WbLoctbOgxIGsbEnqCGQFVQ58QxPGxQWAoD29iGpJh1u4o58CTPtL2Uz05xsj828f1O6yrUZ4wB7QWtCH2RhcdRGOnehCh9ikg__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA>
[Accessed 9 May 2022].

Van Balen, T. (2019). *Challenges of Early Stage Entrepreneurs: The Roles of Vision Communication and Team Membership Change*. Ph.D. Erasmus University Rotterdam.

Vandor, P., Hansen, H. and Millner, R. (2012). Supporting Social Entrepreneurs - The effects of organizational maturity and business model on perceived support needs. *Wirtschaftsuniversität Wien*, [online] Available at: <<https://epub.wu.ac.at/3830/>> [Accessed 25 November 2021].

Waddell, S., 2016. *Change for the audacious - Doer's Guide*. NetworkingAction.

Waddell, S., 2016. *Change for the Audacious a doer's guide to Large Systems Change for flourishing futures*. Networkingaction.

Waddock, S., Meszoely, G., Waddell, S. and Dentoni, D., 2015. The complexity of wicked problems in large scale change. *Journal of Organizational Change Management*, [online]

- 28(6), pp.993-1012. Available at: <<https://www.emerald.com/insight/content/doi/10.1108/JOCM-08-2014-0146/full/html?journalCode=jocm>> [Accessed 9 May 2022].
- Wallace-Wells, D., 2018. *The uninhabitable earth*. New York: Columbia University Press.
- Wanner, T., 2014. The New 'Passive Revolution' of the Green Economy and Growth Discourse: Maintaining the 'Sustainable Development' of Neoliberal Capitalism. *New Political Economy*, [online] 20(1), pp.21-41. Available at: <https://www.tandfonline.com/doi/full/10.1080/13563467.2013.866081?casa_token=AGopymVXEMgAAAAA%3AcuRGXajrq7928dDtWclTf_OuJUqAt39Yxlyjw8IBKgPzbr_TsmcbI_Kf1ypz-qKB7WyhR5037aQ> [Accessed 2 May 2022].
- Western Noray Research Institute, 2017. *Lokale kjelder for proteinfor tilbusdyr og fiskeoppdrett på Vestlandet*. [online] Available at: <<https://www.vestforsk.no/sites/default/files/2017-12/vf-notat%209-2017%20Protos.pdf>> [Accessed 20 March 2022].
- Whitehead, D. and Lopez, V., 2013. Sampling data and data collection in qualitative research. *Nursing & Midwifery Research: Methods and Appraisal for Evidence-Based Practice*, [online] 4. Available at: <https://www.researchgate.net/publication/255950308_Sampling_data_and_data_collection_in_qualitative_research> [Accessed 14 May 2022].
- Wiek, A., 2015. *Solving Sustainability Problems - Tools for a New Generation of Professionals*. 1st ed. Tempe: School of Sustainability, Arizona State University.
- Wiek, A., Ness, B., Schweizer-Ries, P., Brand, F. and Farioli, F., 2012. From complex systems analysis to transformational change: a comparative appraisal of sustainability science projects. *Sustainability Science*, [online] 7(S1), pp.5-24. Available at: <<https://link.springer.com/article/10.1007/s11625-011-0148-y>> [Accessed 10 April 2022].
- Williams Middleton, K. and Nowell, P. (2018). Team trust and control in new venture emergence. *International Journal of Entrepreneurial Behavior & Research*, 24(4), pp.882-910.
- Wilson, M. and Wu, J., 2016. The problems of weak sustainability and associated indicators. *International Journal of Sustainable Development & World Ecology*, [online] 24(1), pp.44-51. Available at: <<http://leml.asu.edu/jingle/Wu-Publications-PDFs/2017/Wilson+Wu-2016-The%20problems%20of%20weak%20sustainability%20and%20associated%20indicators.pdf>> [Accessed 11 May 2022].

World Commission on Environment and Development, 1987. *Report of the World Commission on Environment and Development: Our Common Future*. Our Common Future. [online] Oxford: Oxford University Press. Available at: <<https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf>> [Accessed 11 April 2022]. p. 39.

Wulfson, M., 2001. The Ethics of Corporate Social Responsibility and Philanthropic Ventures. *Journal of Business Ethics*, [online] 29, pp.135-145. Available at: <<https://link.springer.com/article/10.1023/A:1006459329221>> [Accessed 15 May 2022].

Yu, J., 2021. Understanding the Action-based Research for Strategic Change from Systemic Perspectives. *GLOBAL BUSINESS FINANCE REVIEW*, [online] 26(4), pp.1-13. Available at: <<https://www.proquest.com/docview/2655126492?fromopenview=true&pq-origsite=gscholar>> [Accessed 5 May 2022].

Zexian, Y. and Xuhui, Y., 2010. A revolution in the field of systems thinking-a review of Checkland's system thinking. *Systems Research and Behavioral Science*, [online] 27(2), pp.140-155. Available at: <<https://onlinelibrary.wiley.com/doi/abs/10.1002/sres.1021>> [Accessed 8 May 2022].

Zinnbauer, B., Pargament, K. and Scott, A., 1999. The Emerging Meanings of Religiousness and Spirituality: Problems and Prospects. *Journal of Personality*, [online] 67(6), pp.889-919. Available at: <<https://onlinelibrary.wiley.com/doi/10.1111/1467-6494.00077>> [Accessed 7 April

APPENDIX A – ADDITIONAL FIGURES AND TABLES

A.i Motivation map

The meaning of “Their motivation” in the map is the motivation for changing the current system (change the current solution), and “What can be changed” is how the system can be changed for the better or worse for that actor (how their situation will change).

Table 4: The motivation map (Based on table in book Stroh, 2015)

The Stakeholder Map				
Actor	Current support:	Desired support	Their motivation for change	What can be changed
Brewery	1	3	Better economic and logistic solution for SG handling.	Making the SP handling more profitable and easy.
Animal farmer	3	-3	Not to lose the situation of free spent grain.	Lose a source of free SG. Find other cheap, sustainable feed sources.
Waste management service	2	-1	Earns profit on SG handling that is not picked up by farmers.	Lose a source of income. Find other waste sources.
Grain Producer	0	2	Not get a competing product.	Be part of the new system by using existing knowledge, infrastructure, and network.
Grain farmer	0	0	None	None
Malting house	0	0	None	None
Wholesale Distributer	0	2	Not in the current system.	Be part of the new system. Potential profit from sales of a higher-priced product.

Grocery store (retailer)	0	2	Not in the current system.	Potential profit from sales of a higher-priced product.
Restaurant	0	2	Not in the current system.	Potential profit from sales of food with a new raw material.
Startp making human food of spent grain	3	3	In current system by handling tiny percentage of SG in the system.	Potential for more financial gain by upscaling and handling more SG.
Researcher (economist)	1	3	In the current system provides research on SG and foods.	Feel important because his research is used in practice
Researcher (nutritionist)	1	3	In the current system providing research on SG and foods.	Feel important because their research is used to change a system for the better.
Drying company	0	3	Not in the current system.	Be part of the new system by drying the SG for a longer shelf time.
Mill	0	2	Not in the current system.	Potential for new customers that need milling.
Baker/ food producer	0	2	Not in the current system.	Potential for a new source of raw material (ingredient).
Plant-based milk producer	0	1	Not in the current system.	Potential for a new product.

The meaning of "Exposed purpose" in the table is the purpose the actor wants to convey to external the rest of the system and the world. In contrast, "Hidden priorities" are the motivation for change that is more secret and maybe more egocentric, benefiting the actor or company. The first table presents the *purpose of being part of the current system* and includes the three main actors we identified as important for the current solution.

A.ii Hidden vs exposed priorities

Table 5: Hidden vs Exposed Priorities - Purpose of Collaboration for actors (Based on table in book Stroh, 2015)

Purpose of collaboration general actors
--

Role	Espoused purpose	Hidden priorities
Brewery	Want to donate SG to farmers to give them a good deal, and to be more “sustainable” by contribute to a more circular economy.	Want to minimize expenses and stress when getting rid of SG.
Animal farmer	Wants to use SG as animal food to give animals high protein feed and for being more “sustainable” by using a waste product.	Wants cheap and easy source of animal feed.
Waste management service	Wants to handle SG to create a more circular economy by treating SG as biowaste and creating energy in terms of biogas.	Wants to earn money on SG handling. (However, does not earn enough on SG handling for financial surplus)

The second table presents the *purpose of being part of “a potential future” system* and includes all actors we saw relevant for being part of a new system.

Table 6: Hidden vs Exposed Priorities - Purpose of Collaboration for all actors (Based on table in book Stroh, 2015)

Purpose of collaboration general actors		
Role	Espoused purpose	Hidden priorities
Grain producer	Potentially contribute to an improved national grain system as a whole.	Alternative supply chain and more secure system.
Grain farmer	Potentially contributes to an improved national grain system as a whole.	Maintain or increase production.
Malting house	Potentially contributes to an improved national grain system as a whole.	Alternative supply chain and more secure system.
Wholesale Distributor	Sell more sustainable products.	Share of a more expensive product.
Grocery store (retailer)	Have more sustainable products in its shelves.	Share of a more expensive product. PR from the use of more sustainable products.

Restaurant	Market local, more circular raw material in food. Used for storytelling and brand image.	Good PR might attract more customers. In addition to access to low-cost raw material, profit increase.
End user	Availability of new environmentally friendly and healthier products.	Lessens guilt of other less environmentally friendly choices. Want to buy health products to look and feel better.
Start-up making human food of spent grain	Expanding the SG market, creating awareness and deliver a more circular solution to the problem of SG waste.	Increase sales of product/service and gain higher profits.
Researcher (economist)	Contribute to research about System change.	More data for further research and recognition of research.
Researcher (nutritionist)	Contribute to research about System change.	More data for further research and recognition of research.
Drying company	Machines/technique used for a more environmentally friendly solution of SG handling.	Increase sales of product/service and gain higher profits. Gain network, potential business partners and marketing.
Mill	Diversity in income, and taking part in creating a new type of product.	More diverse revenue streams, costs of spent grain might be lower than normal grain.
Baker/ food producer	Use SG as trendy and sustainable raw material.	Potential free PR of using trendy and healthy raw material. Risk of being the first to try, and no product-market fit.

The third table was made later in the process (see *Step 2: Facing Current Reality - Building support by bringing the system to life*), and also presents the *Purpose of being part of the "future" system*, but with the three key actors identified in this project to deliver the solution of spent grain handling. The solution is that the spent grain is dried by Arendals Bryggeri (brewery), then it is picked up and handled by Cernova Industri (Mill) and bought and produced into animal feed by Felleskjøpet Fôrutvikler (Animal feed producer).

Table 7: Hidden vs Exposed Priorities - Purpose of Collaboration for the key actors (Based on table in book Stroh, 2015)

Purpose of collaboration key actors		
Role	Espoused purpose	Hidden priorities

Møllerens	Contribute to a more circular economy by handling a bi-product treated as waste, and converting it to a product of higher value. Help breweries out by creating a more reliable and profitable solution for them.	Gain a new source of raw material for a low cost. Use animal feed as a pilot project to establish processes, to later continue with human consum for higher profit. Sell a high pricec product for a new consumer market.
Arendal bryggeri	Take responsibility for own waste product, and create something of higher value, contributing to a more circular economy.	Get a new solution to SG handling, with as little extra fuzz as possible. Wants brewing to remain their main and only activity, but earning profit by selling SG as an additional benefit.
Felleskjøpet	Contribute to a more circular economy by handling a bi-product treated as waste, and converting it to a product of higher value. Help breweries out by creating a more reliable and profitable solution for them.	Get an ingredient for animal feed that is cheaper and more “sustainable” in terms of marketing value.

The fourth and last map presents the *purpose of being part of a pilot- project, testing out a new system*. The pilot project is the testing of the new supply chain between Arendals Brygegri (brewery), Cernova Industri (Mill), and Felleskjøpet (Animal feed producer).

Table 8: Hidden vs Exposed Priorities - Purpose of Collaboration in pilot project (Based on table in book Strob, 2015)

Purpose of collaboration key actors		
Role	Espoused purpose	Hidden priorities
Møllerens	Wants to contribute to the research of local and more sustainable source of animal feed ingredient. Say they are interested in helping the master project, and get help from us as students to help develop their project.	Use the pilot-project of creating “more sustainable animal feed” as cover-up to obtain financial support from research institutions, establish processes and infrastructure, to later continue with human consum for higher profit. They may obtain “free” information more easily from other companies through students with no other agenda than writing a master thesis.
Arendal bryggeri	Wants to contribute to the research of local and more sustainable sources of animal feed ingredients. Wants their SG to be used in a test run of a better solution for SG handing on a system level.	Free (potentially a little profit) SG handling in the pilot period. Potential entrance ticket to becoming part of a new supply chain. Piggyback on larger companies, by starting collaboration.

Felleskjøpet	Wants to contribute to the research of local and more sustainable source of animal feed ingredients.	Owns 66% of møllerens, and is therefore in their interest that they both succeed. Research on alternative sources of raw materials for animal feed, in their interest, if means more sources and potentially cheaper.
--------------	--	--

A.iii Stakeholders in the Spent Grain system,

By looking both at actors involved in the process vertically through the supply chain and the potential value of the grain in a life cycle assessment (see system maps), a diverse group of stakeholders was identified. In addition, we went broad when identifying stakeholders, by looking at all possible current solutions to spent grain handling, and all other possible solutions. A broad group of stakeholders was identified in the current system for spent grain handling. Actors marked with (*) are not part of the current system of spent grain handling but is part of the system surrounding the production of beer. Actors marked with a (**) are not part of the current system of beer production or spent grain handling, but are potentially part of a potential future system where there is a different solution for how the spent grain is handled. The only three key stakeholders identified as being actively part of the current process of spent grain handling are the brewery, the animal farmer, and the waste management service.

Table 9: Stakeholders in the Spent Grain System

Stakeholders in the Spent Grain System
Brewery
Animal Farmer
Waste management Service
Grain Farmer*
Grain producer *
Malting house*

Wholesale distributor *
Retailer (grocery store)*
Restaurant*
End-user*
Start-up making human food of spent grain**
Researcher (economist)**
Researcher (nutritionist)**
Drying company**
Mill**
Food producer**

A.iv The Iceberg model

Table 10: The Iceberg Model for the System of Spent Grain Handling (Based on table in book Stroth, 2015)

The IceBerg Model for the System of Spent Grain Handling		
Elements in the current system Structure (2022) of the system of spent grain handling	Trends and patterns in the world affecting the system of spent grain handling	Events that have affected the system of spent grain handling (inc. year of the event)

(Policy) Svalbard Environmental Protection Act demanding no waste disposed on the island, thus spent grain handling being a problem for the island's brewery.	More awareness of environmental protection.	The Svalbard Environmental Protection Act was implemented 2012.
(Purpose) Svalbard Bryggeri is an innovator of system change in the system of SG handling by creating a 100% circular model for SG handling.	Circular business models on Svalbard.	Svalbard Bryggeri invested in drying and burning machines, 2015. Implemented a circular model where the brewery dries and burns the BSG to produce energy for the brewery.
(Policy and political pressure) Policies and political pressures for the centralization of farming in Norway, making it beneficial for economies of scale.	Centralization of farms and breweries in Norway (general global trend).	“Jordbruksopprøret” (The agricultural uprising), 2014. Creating law benefitting the largest farms. Centralization of farms, making them further away from breweries, makes logistics for BSG handling harder.
(Pressure and policy) Voluntary ban between traders to purchasing un-licensed soy. Thus increasing the demand for other high protein raw materials for animal feed.	The controversy surrounding Amazon deforestation.	Amazon Soy Moratorium was created in 2006 and renewed in 2016.
(Policy and pressure) Norwegian government implemented policies to strengthen the fishing industry. With the growth of the fishing industry, the need for high protein fish feed increases.	Norway increases of the import of soya, due to growth in the fishing industry.	“Salmon on soybeans — Deforestation and land conflict in Brazil” report published, 2018. Need for new sources of protein for fish feed. SG, If fed to insects, spent grain can replace soy. (Framtiden i Våre Hender, 2014)
(Policy) SG is not considered food waste as it does not have the purpose to become human consumption. Thus, there are no penalization for treating it as waste.	Higher demand for circularity and measures for a more circular economy.	Bransjeavtalen om reduksjon av matsvinn (Industry agreement on reducing food waste), 2017. (Bransjeavtalen om reduksjon av matsvinn, 2022)

(Pressure and policy) Higher market demand for sustainable solutions, circular business operations, and policies and regulations implemented by states.	Climate change and extreme weather affect grain farming/production.	Drought in Europe creating a shortage of grain, summer 2018.
(Purpose) After the 2018 drought, animal farmers continue to use wet spent grain as animal feed due to the low cost.	Unreliable harvest of crops due to extreme weather.	Due to the 2018 drought, animal farmers started using wet spent grain as animal feed due to a shortage in grain.
(Pressure and policy) Higher market demand for circularity, more circular business operations, and policies and regulations implemented by states.	Higher demand for circularity and measures for a more circular economy.	EU Circularity Plan, 2021.
(Power dynamic) Change of power dynamics in the market forces (especially relevant gas and grain) due to EU sanctions.	Global and EU shortage of Russian imports (especially relevant gas and grain).	The Russian invasion of Ukraine, 2022 (Huanga and Lua, 2022).
(Pressure) Demand for grains has not met with the shortage due to the Russian invasion of Ukraine.	The majority of cereals consumed in Norway are imported (the main import country being Kazakhstan).	Grain demand record high, 2022. Causing high demand for stable, Norwegian grain (FAO Food Price Index, 2022).
(Pressure) Pressure for cheaper alternative solution for energy supply.	Global and EU higher demand for gas.	Energy costs in Norway record high, 2022 (Holstad, 2022).

A.v System Maps:

Figure 11: System map for brewery

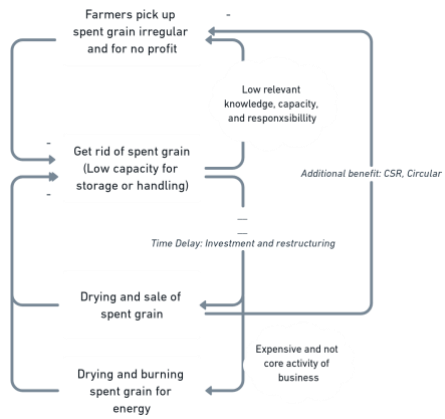


Figure 12: System map for animal feed producer

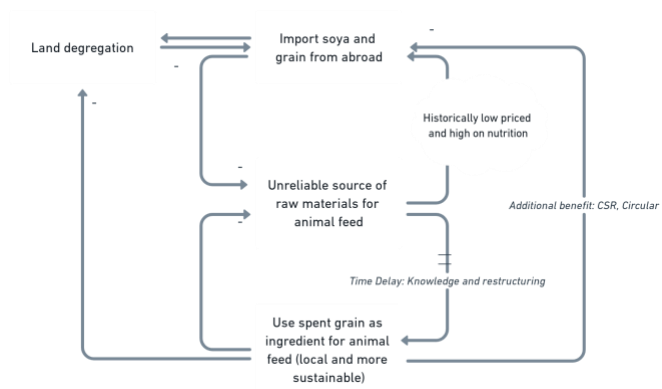
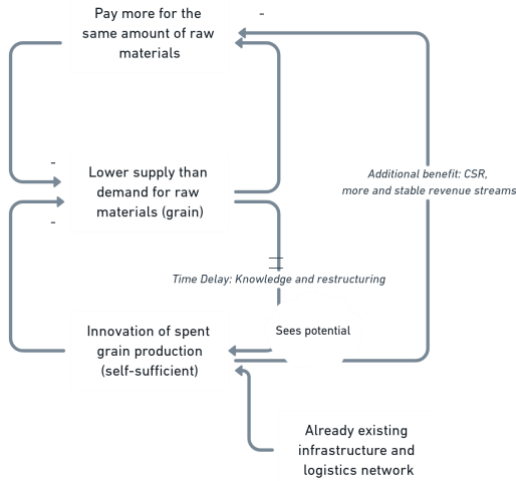


Figure 13: System map for mill



Note: These have not been updated since our last mentor meeting with Stroh.

A.vi Mental models

The mental models in the table is based on research and data collection and reflection made throughout the research process. However, the opinion of the actor presented in this table is generalized to the general behavior in a system. For example quotes written for “Brewery” does not represent Mack, or Sagene Bryggeri or Arendals Bryggeri. They are exaggerated mental models based on general assumptions of the actors in the system. But with fictive opinions based on research and insight from data collected. The mental models are exaggerated with the purpose for us as researchers to understand the key barriers of each actor hindering change of the system.

Table 11: Mental Models of Key actors (Based on table in book Stroh, 2015)

Mental models of key actors in the system of "Spent Grain Handling"				
	Animal farmer	Brewery	Flour Producer	Animal Feed Producer
Defiance	"We get the spent grain for free, so its fine for us if we have to find another source of animal feed."	"It is not our responsibility to find a better solution, giving it away to farmers is a great solution."	"This is not our filed or responsibility, we will not do anything if it doesnt serve us."	"We dont want to change a system that gives free spent grain to farmers."

Fear	<i>"It would be scary to one day realize we don't have a source of feed anymore for our animals"</i>	<i>"It would suck to be blamed for being bad at food waste management, people might think we don't care about the environment."</i>	<i>"It's scary to take the risk of entering a new market, what if we fail..."</i>	<i>"What if the farmers that buy products from us, is not happy with a potential new product."</i>
Entitlement	<i>"We drive all the way to pick up the spent grain, and help the breweries get rid of it, so we can do whatever we want with it, rotting in the field if it comes to it."</i>	<i>"We are not breaking any laws, so the option we chose for spent grain handling is the best either way."</i>	<i>"We are the best at what we do in the country, and the breweries are lucky to get the change to collaborate with us."</i>	<i>"Soy is much higher in protein and is a great ingredient for animal feed, we're not reliant of any other raw material."</i>
Desperation	<i>"With all the hard work around the farm, its nice to have a reliable and free source of animal feed, we don't want to loose that."</i>	<i>"We cannot rely on the farmer coming at irregular times and for no profit, our beer production might stop up if we don't find a solution that is works better for us long term."</i>	<i>"We desperately need new sources of raw materials due to the unstable grain supply in the world."</i>	<i>"With the unstable times globally, it might be good to have another source of raw material for our animal feed, we don't want to let down all the farmers."</i>
Ignorance or functional illiteracy	<i>"If we don't take the spent grain, it is going to go to waste, so its better that we take it."</i>	<i>"We believe we have chosen the best and most sustainable solution of SG handling."</i>	<i>"No one is going to want to buy food products made from food waste."</i>	<i>"There isn't any better ingredient than soy to put in animal feed."</i>
Recognition	<i>"We provide the best solution to the problem so far so the brewery should be happy."</i>	<i>"We have chosen the best and most sustainable solution, and it isn't even our responsibility."</i>	<i>"Doing something with spent grain is not in our field, so we should get praise for even trying."</i>	<i>"We are doing the other a favor by helping out with our knowledge and resources, to create a new system."</i>

A.vii Understanding Payoffs in the existing system

The brewery is the only actor of the three chosen for a new system that is already part of the current system of spent grain handling. As the flour producer (Cernova industri) and the animal feed producer (Felleskjøpet forutvikling) is not part of the current system of spent grain handling, when "current system" is mentioned from their perspective, its referring to the system surrounding their key activity, such as producing flour. The "payoffs existing system" refers to the benefits each actor obtain from being in the current system, and "The switching cost" is cost in terms of resources and time needed to create the change.

Table 12: Understanding Payoffs in the Existing System (Based on table in book Strob, 2015)

Understanding Payoffs in the Existing System

	System of spent grain handling (Arendal Bryggeri)	System of flour production (Cernova Industries)	System for animal feed production (Felleskjøpet Forutvikling)
Payoffs existing system			
Procedural	Farmer picks up SG weekly, but still a bit irregular.	Have a well functioning system of flour and cereal product production.	Have a well functioning system of imported protein, with decent import prices and big quantities.
Financial	No cost of getting rid of SG as farmer takes it for free, but also no profit from giving it away.	They earn profit from flour sales.	They earn profit from animal feed sales.
Relational	Good deal with farmer which benefits both, but farmer is a bit unreliable.	Good logistics and collaboration and links in supply chain, very established customer segment.	They have good relationship with supplier and customers (farmers) - do what's best for farmers (they have trust).
Switching cost			
Procedural	Time and effort used for research, planning, collaboration and restructuring operation.	Time and effort in obtaining knowledge, and making strategy for new supply chain and operations.	Research new ingredient, restructuring operations of products including new ingredient.
Financial	Investment in drying machines, salary for new specialized employee, training etc.	Investment of new product in terms of equipment and materials for new operations, as well as cost of investing in marketing and sales for new market segment.	Investment in testing out raw material nutritious value. (Pilot project not financially viable due to low quantities).
Relational	New customer relationship, change of supply chain, employees need to adapt to new routines.	New customer and supplier relationships. In addition to, research and mapping of new customer market, marketing and selling of new product.	New supplier relationship, sell new product to farmers and they have to adapt.

A.vii The case of changing vs the case of status quo

The table below looks at “Benefits of change” vs “cost of not changing”. It is made by us, as an interpretation of how the actors themselves see this. The purpose was to map out the motivation and realistic roadmap of change of system. As mentioned in the previous step, the brewery is

the only actor of the three chosen actor for a new system, that is already part of the current system of spent grain handling. As the flour producer (Cernova industri) and the animal feed producer (Felleskjøpet forutvikling) is not part of the current system of spent grain handling, when “current system” is mentioned from their perspective, its referring to the system surrounding their key activity, such as producing flour. The answeres are means to answer “the benefots of chaging” and “the cost of not chnaging” focuse don the case for change.

Table 13: Compare the case of change with the case of status quo (Based on table in book Strob, 2015)

Compare the case of change with the case of status quo			
	System of spent grain handling (Arendal Bryggeri)	System of flour production (Cernova Industries)	System for animal feed production (Felleskjøpet Forutvikling)
The case for change	<i>System of spent grain being made into flour and potentially animal feed</i>		
Benefits of changing			
Procedural	Stable and efficient spent grain handling (integrated in operations)	Little time and effort needed for chnage, Very efficient logistic solution delivering malt and picking up spent grain	Little time and effort needed for change
Financial	New source of income, potential lower cost of energy	Increased ability to receive govermental funding, new source of income (new product line/market)	New cheap and local source of raw material (table and lower price)
Relational	More stable customer/handler of spent grain	New potential product, market and customer segement	Stable and local supplier of raw material
Costs of not changing			
Procedural	Posibility of operations disturbed by lack of successful SG handling, as farmers are centralizing, and the system becomes less reliable.	Possibly, the time and effort finding other alternatives for new products.	Possibly, the time and effort for finding other alternative raw materials.

Financial	Higher energy prices increases costs of operations, in addition to the opportunity cost of not selling the SG.	Increase of prices for imported raw materials, as well as higher energy prices making cost of production higher.	Increase of prices for imported raw materials, as well as higher energy prices making cost of production higher.
Relational	Loosing deal with farmers and loss of solution for SG handling.	Loss of customers, as they are not willing to pay more for same product.	Loss of customers, as they are not willing to pay more for same product.

A.ix Polarity models

The left side is for “chnage”, the right side is for “status quou” or no change, the top is for the “hope” or best possible scenario, while teh bottom is for the “fear” or worst case scenario.

Table 14: Polarity model for system of spent grain handling (Arendals bryggeri) (Based on table in book Stroh, 2015)

Hope	
Left pole positives (Change)	Right Pole positives (status quo)
Stable and profitable system of spent grain handling	Maintain stable handling of spent grain
Left pole negatives (change)	Right pole negatives (status quo)
Risk of failed investment, no ROI, or risk of new supply chain not working.	Complete disruption of production operation and decrease revenues because farmers stop picking up the spent grain and renovation must.
Fear	

Table 15: Polarity model for system of flour production (Cernova Industri) (Based on table in book Stroh, 2015)

Hope

Left pole positives (Change)	Right Pole positives (status quo)
Marked leaders in new emergent market with "health products"	Do not have to gain knowledge of new industries
Left pole negatives (change)	Right pole negatives (status quo)
Risk of failure supply chain not working, or no demand of spent grain	Climate change and political unrest leads to supply of grain decreases, price increase drastically
Fear	

Table 16: Polarity model for system for animal feed production (Felleskjøpet forutvikling) (Based on table in book Strab, 2015)

Hope	
Left pole positives (Change)	Right Pole positives (status quo)
Finding an alternative feed supply that can be used large scale	Animal feed decreases naturally in costs, and no need to find alternative sources.
Left pole negatives (change)	Right pole negatives (status quo)
Uses time and resources, investing in something that does not give ROI	Climate change and political unrest leads to supply of grain decreases, price increase drastically
Fear	

A.x Identify high leverage interventions

To structure how the system can be affected at different levels, we chose to look wider than that of brewers spent grain. We used the twelve leverage points by Donella Meadows as basis. First we discussed what each of the leverage points are, then we discussed how they can apply to the three different sectors we ended up working with. Lastly we looked at what can be changed in these industries, at the appropriate leverage point, and whom that can do that change. As leverage points are best "attacked" at the root, we decided to allow ourselves to go broader than the handling of brewers spent grain in itself.

Table 17: High leverage interventions (Based on table in book Stroh, 2015)

Leverage point	Type	Aim	Identify how this can be for the system of spent grain handling
12. Constants, parameters, numbers (such as subsidies, taxes, standards)	Physical	Change the flow rates of system inputs and outputs. Whether material, energetic or otherwise.	Defining BSG as foodwaste legally, impose economic subsidies on BSG as alternative to grain
11. The sizes of buffers and other stabilizing stocks, relative to their flows.		Optimize stock buffers size to maximize resilience and efficiency.	Increasing the time period the value of the BSG can be utilized, through innovative technology (e.g. drying)
10. The structure of material stocks and flows (such as transport networks, population age structures)		Build the system right, rebuild it, or understand the system limits and don't exceed them.	Create transportation networks for breweries, Designing the brewers spent grain system, simultaneously of those regrading the substitutes (such as soy), so that all products get utilized. Having farmers closer to breweries, and transport network with malt, grain etc.
9. The lengths of delays, relative to the rate of system change	Informational	Change the rate of system responses.	Time delay from restructuring operations and supply chain, time delay on return on investments, time delay on technology and information sharing
8. The strength of negative feedback loops, relative to the impacts they are trying to correct against		Change the stabilising potential in the system (negative feedback loops, broadly speaking, are stabilising or corrective)	Reducing dependencies on trade. Catastrophes (such as war, climate) affecting food production relative to the demand of food.
7. The gain around driving positive feedback loops		Changing the gain (destabilisation or reinforcing potential) in the system	Replacing grain with spent grain, reduces import, reinforces the rate of norwegian self sufficiency.
6. The structure of information flows (who does and does not have access to what kinds of information)		Explore and alter who has access to what information	Create a "nudge" based on scientific information regarding sustainability and spent grain. Connecting information of potential uses, involving under which circumstances they are sustainable.

5. The rules of the system (such as incentives, punishments, constraints)	Social	Understand and change what the rules are and who has power over them, Natural laws, constitutions and social agreements all fall into this category.	Impose strict rules on how you are allowed to dispose BSG, fines if not followed, forcing all companies to find better solutions
4. The power to add, change, evolve, or self-organize system structure		Nurture innovation, flexibility, variation, culture, creativity, collaboration: the adaptive capacity of the system	Cross-industrial collaborations with alternative uses of BSG and alternative business models
3. The goals of the system		Create and/or remove selection pressures on the system	Changing the goal of the system from economic growth to increase circularity norwegian self-sufficiency
2. The mindset or paradigm out of which the system—its goals, structure, rules, delays, parameters—arises	Conscious	Challenge the assumptions and values we hold to be true. Self-reflection, cultural variation, activism: it is the from our paradigms about the nature of worlds that our goals arise.	Shifting the business culture to one where unity among all humans and nature is in focus.
1. The power to transcend paradigm		Recognise the limitations of our understanding and utilise this as a source of eternal flexibility, humanity and learning.	Engaging multiple perspectives, and mapping out a system which recognizes all

APPENDIX B – SEMI-STRUCTURED INTERVIEW GUIDE

Semi-structured Interview guide:

Brief about the project:

As mentioned earlier in the project brief, we are writing our master's thesis on system change. We want to focus on the handling of by products from beer production in Norway. We have seen that *insert relevant best practices, examples Agrain making flour in Denmark and Yorkshire Pizza Club creating doughs from spent grain* internationally. We talk to you today to gain insight from your/(your business) perspective as you are part of the current system. We want to find out WHY aren't you earning more money on the spent grain, while becoming more environmentally friendly?

Questions about interviewee

- What is your job within, or related to, beer production?
- What do you think is a “sustainable” way to use spent grain?

Questions about current system

- What systems for handling spent grain do you know of?
- Research, and international companies, shows that spent grain has the potential to use more resources economy efficient, than for animal feed *introduce best practices* Why are you, and the actor you present, not doing this?
- What are the biggest obstacles to you not using the mask more effectively? Name 3.
 - Why do these obstacles exist?
- To what extent do you view mask handling as part of a larger, larger picture? (natural resources etc).
- What works well in today's mask handling system? / Or in relation to your industry related to the topic.
 - What does not work?
- How do other players in the system's handling of the mask feel (what works for farmers, breweries etc)?
- What parts of the mask system can be affected by your company?
- What is the purpose of the current mask handling system?

Questions about future system:

- If the answer is to get rid of the mask, then it is a good system.
 - what do you think a successful system would look like?
 - Who MUST be involved?
 - Who are interested to be involved?
 - Who has the power, money and ability to create this system?
 - You described what you think a successful system would look like. How can this system contribute to your success?
 - eg finance, marketing, less stress etc.
- If the answer is sustainability and making money, maybe the system should be changed, so it does that. If the former may need to change the basic purpose of the system. ref. leverage points.
 - what do you think a successful system would look like?
 - Who MUST be involved?
 - Who are interested to be involved?
 - Who has the power, money and ability to create this system?
 - You described what you think a successful system would look like. How can this system contribute to your success?
 - eg finance, marketing, less stress etc

APPENDIX C – CONCENT-FORM

Samtykke for inkludering i Masteroppgaven:

The framework “Systems Thinking for Social Change” Applied in Practice using Action Research.
Collaboration for Circularity in the system of Brewers Spent Grain handling

Formålet med oppgaven

Forskningsprosjektet er en masteravhandling som har som formål å teste ut rammeverket “*System thinking for social Change*” av bestselgende forfatter David Peter Stoh. Det gjøres gjennom aksjonsforskning på systemet og aktorene i systemet rundt håndteringen av mask - et biprodukt fra ølbrygging. Rammeverket har som formål å løse kompliserte utfordringer i samfunnet i dag.

Målet med oppgaven er å besvare forskningsspørsmålet og medfølgende under-forskningsspørsmål:

Problemstilling: “*How does the framework “Systems thinking for social change” work in practice?*”.

Forskningsspørsmål:

Sub-question 1: “*What are the weaknesses of the framework when applied in practice?*”

Sub-question 2: “*What are the strengths of the framework when applied in practice?*”

Sub-question 3: “*Does the framework applied in practice stimulate actors to create change in a system?*” Sub-question 4: “*How can the framework be improved to better complement practical use?*”

Hvilken institusjon er ansvarlig for forskningsprosjektet?

Norges Miljø og Biovitenskapelige Universitet er ansvarlig for prosjektet med studentene Fam Leborg og Eva Nagelhus i spissen. Matthew Lynch er professor og masterveileder for prosjektet. I tillegg får prosjektet mentor-assistanse fra David Peter Stroh og Simen Knudsen. Stroh er grunnleggeren og forfatter av rammeverket som brukes. Knudsen er bærekraftsansvarlig i Æra Strategic Innovation som driver med organisering av systemendring for å løse problemer eller såkalte “Flokke” i det Norske samfunnet.

Hvorfor blir du spurt om å være med?

Du har blitt spurt om å delta, fordi du arbeider i et selskap som vi ser på som en essensiell aktør i systemet som skal kartlegges i oppgaven. Vi ønsker å høre om dine erfaringer og tanker rundt systemet på vegne av ditt selskap, for å kunne kartlegge fremtidige systemer og løsninger.

Hva betyr det at du velger å godkjenne deltakelse?

Hvis du velger å samtykke til deltakelse i masterprosjektet innebærer dette at vi bruker følgende data:

- Navn på selskapet du arbeider for.
- Stillingen din i selskapet.
- Merk at navn på personer **ikke** vil bli brukt i oppgaven.
- Informasjon delt i intervju - 40-60 minutters intervju.
- Merke at det **ikke** vil bli brukt taushetsbelagt informasjon om interne forhold i din organisasjon eller person opplysninger om tredjepersoner.
- Det vil heller **ikke** bli brukt opplysninger om tekniske innretninger og fremgangsmåter samt drifts- eller forretningsforhold som det vil være av konkurransemessig betydning å hemmeligholde av hensyn til den som opplysningen angår.

Som en del av prosjektet har det blitt samlet inn bakgrunnsinformasjon om alle aktørene som enten håndterer mask, har en intensjon om å håndtere mask, eller har generell kunnskap om mask og systemet rundt.

Informasjonen omhandlede deg og ditt selskap vil kun bli brukt til å forstå systemet i en større sammenheng og oppgavens fokus er på hvordan man kan skape systemendring i praksis. Ettersom vi skriver om systemendring i praksis, er vår master **fokusert på prosessene for systemendring og det spesifikke rammeverket som brukes som et verktøy – ikke selskapene eller produktene som kan følge av et samarbeid**. Data presentert i oppgaven vil være erfaringer og refleksjoner fra å bruke rammeverket, inkludert intervjuene, desk research. De potensielle produktene, produktinformasjonen og data spesifikke for bedrifter vil derfor være av liten interesse for oppgaven. Vi ønsker imidlertid å kunne nevne hvilke bedrifter vi har hatt intervjuer med, og hvilke stillinger intervjuobjektet hadde i bedriftene, når det er hensiktsmessig. Det kan også bli brukt eksempler fra intervjuer fks. eller situasjonene til en bedrift, for å illustrere et argument.

Det er frivillig å delta

Det er frivillig å delta i forskningsprosjektet. Du kan når som helst trekke samtykket tilbake uten å oppgi noen grunn. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

Ditt personvern – hvordan vi vil lagre og bruke dine personopplysninger

Vi vil kun bruke dine personopplysninger til formålet som er spesifisert her, og vi vil behandle dine personopplysninger i samsvar med databeskyttelseslovgivningen (GDPR).

Persondata som samlet inn som: navn, e-post og telefonnummer, vil kun være brukt som et hjelpemiddel til datainnsamling, og organisering av notater. Deltakerens persondata vil kun være tilgjengelig for forfatterne av oppgaven: Eva Helene Nagelhus og Fam Leborg, samt prosjektets veileder Matthew Lynch. Eksempelene på persondata nevnt over vil **ikke** bli brukt i oppgaven.

Den eneste persondata som vil bli brukt i oppgaven er kobling av stilling i selskap og selskapsnavn. Og deltakere vil dermed **kun** være gjenkjennelige i publikasjoner gjennom kobling av stilling i selskap og selskapsnavn.

Hva vil skje med dine personopplysninger på slutten av forskningsprosjektet?

Den planlagte sluttdatoen for prosjektet er *13. juni 2022*. All persondata vil - utenom selve oppgaven - vil bli slettet etter endt prosjekt.

Dine rettigheter

Så lenge du kan identifiseres i de innsamlede dataene, har du rett til:

- få tilgang til personopplysningene som behandles om deg
- be om at dine personopplysninger slettes
- be om at uriktige personopplysninger om deg blir rettet/rettet
- motta en kopi av dine personopplysninger (dataportabilitet), og
- sende en klage til Datatilsynet angående behandlingen av dine personopplysninger

Hva gir oss rett til å behandle dine personopplysninger?

Vi vil behandle dine personopplysninger basert på ditt samtykke.

Hvor kan jeg finne ut mer?

Hvis du har spørsmål om prosjektet, eller ønsker å utøve dine rettigheter, ta kontakt med:

Prosjektets ledere:

Eva Helene Nagelhus

Mobil: 48041019

eva@nagelhus.com

Fam Leborg

Mobil: 97463331

fam@leborg.com

Prosjektets veileder:

Matthew Lynch

matthew.lynych@nmbu.no

Personvernombud NMBU:

Hanne Pernille Gulbrandsen

Mobil: 402 81 558

personvernombud@nmbu.no

Med vennlig hilsen,

Eva Helene Nagelhus og Fam Leborg

Samtykkeskjema

Jeg har mottatt og forstått informasjon om prosjektet: **“The framework “Systems Thinking for Social Change” Applied in Practice using Action Research”**, og har fått mulighet til å stille spørsmål. Jeg gir samtykke:

- til bruk av data samlet i personlig intervju over zoom/telefon.

Jeg gir samtykke til at mine personopplysninger og informasjon på vegne av mitt selskap behandles frem til slutten av prosjektet.