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Reuse of construction waste in Bodø: An easy way or a thorny path towards smart sustainable city?

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Abstract

Bodø has a vision to be a smart sustainable city in the near future. 'New city new airport' project is the origin of the vision of making smart Bodø, by considering climate and sustainability goals. Growing population and sustainability challenges create the need for new urban planning in Bodø with sustainability in its core. Circular economy is considered an integral instrument for gaining city's sustainability. Bodø municipality wants to utilize circular solution to accomplish resource efficiency, waste management and overall sustainability of the city. Waste generation is an important indicator of the environmental category of smart sustainable city where waste management should be through reuse or recycle. Waste management is guided by circular economy-inspired waste hierarchy that is introduced in European Commission Waste Framework Directive. Reusing waste is the second-best waste management option and widely recognized choice for lesser environmental footprint. Construction sector generates huge environmental footprint because the entire process of extraction, management and material use produce a lot of waste. The climate footprint analysis of Bodø 2017 states that the construction sector in Bodø is liable for 42% of climate footprint. It should be noted that the barriers in construction material reuse include Norwegian regulation and legislation for the sale and utilization of reusable construction materials, based on information in current studies. This thesis focuses on the reuse of construction materials and finds out the associated current practice including reuse market and potential barriers in Bodø, that is going to be a smart sustainable city. Later the findings will disclose the contribution of reuse of construction materials towards smart sustainable vision.

The research philosophy of this thesis is based on interpretivism as I want to gain enhanced and interpretive understanding about the phenomenon of the current practice of reuse of building materials in Bodø. Aligning with the aim of the thesis I selected qualitative research method to gain in depth understanding of the contribution of building material reuse in Bodø. In addition, the case study that I undertook reveals certain facts linked to the phenomenon of reuse of construction materials. Since participation of the concerned stakeholders including citizens in city planning and decision making is considered characteristics of smart sustainable city, for the research, I adopted snowball sampling and conducted interviews with stakeholders of the construction sector in Bodø. This study figured out the significant barriers such as lack of market, logistics, storage facility, funding access, knowledge and experience gap, ambiguity and uncertainty, institutional pressure-induced participation in circular solutions, lack of collaboration among stakeholders that are interrupting the practice of reuse of building

materials in Bodø. Stakeholders seem to be ambiguous about the regulatory barriers that are created for sale and utilization of reusable building materials. Furthermore, there exists a knowledge gap regarding the current regulation and legislation. Among all the barriers, lack of market is the most significant barrier. I analysed the empirical findings based on organisation's decoupling theory from institutional theory since the reuse of building waste is both policy and action that should be practiced and regulated by organizations. This thesis also finds that the organisation's decoupling helps to better understand better policy and practice of reuse of building materials in Bodø. The barriers compel organization to decouple policy from practice and prevent the implementation of policy to attain desired goals. I found that reuse of building material has a significant role, and the action can make Bodø one step forward in the vision of being smart sustainable city. This study reveals that reuse of building materials can bring sustainability in terms of environmental, social, economic, cultural aspects. In addition to these merits, reuse of building materials can add participatory and collaborative governance, technological and smart solution, sustainable urban resource management, and new infrastructure building for the potential smart sustainable Bodø. Based on the findings in this thesis, reuse of building materials can effectively redirect the city's journey to achieve the ambitious smart sustainable city vision.

Acknowledgement

This study has been conducted as a part of the completion of my Master of Science in Global Management from Business school (HHN) of Nord University. This thesis constitutes 30 credits from my master study.

It has been both interesting and challenging for me to conduct a research based on Bodø. But it has given me profound insight about the readiness of potential smart and sustainable city Bodø for circular economy reuse in construction material. The experience built up from conducting this research will be a motivation for me to further research work regarding Bodø municipality.

I am incredibly grateful to my supervisor, Elena Dybtsyna (Associate Professor, Nord University) for her valuable guidelines and support throughout this thesis. It was not possible to finish this report without her feedback and inspirations.

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1. Introduction

Bodø is one of the fastest-growing cities in northern Norway. Bodø municipality with a population of around 55 000 is expected to receive 20 000 more inhabitants by 2030 (Raspotnik, Grønning, & Herrmann, 2020). A rising population is accompanied by a desire and need for innovative projects like 'new city, new airport'. This project is considered an opportunity for Bodø to reorganize and reset the city to align with sustainability and climate goals (Bodø municipality, 2017 (a)) and is connected to the municipality's long-term promises to work towards United Nations (UN) initiative to create smart sustainable cities "United for Smart Sustainable City (U4SSC)''. The aim is to have digital and technological solutions to establish urban sustainability and adopt circular solutions (Bodø municipality, 2021). The origin of smart and sustainable vision, although, came from the 'new city new airport' project, the municipality believes that the developments of the whole city should be already considered instead of waiting for the project to begin (Bodø municipality, 2017 (a))

The municipality board is trying to achieve a circular economy (CE) through reuse and recycling (Bodø municipality, 2017 (b)). ''Reuse'' has a significant role in the CE model. It ranks second in the waste hierarchy, where ''prevention'' is the only other better option, as shown in figure 1. waste hierarchy is considered a CE-inspired paradigm that was introduced in European Commission waste framework directive (European Commission, 2008). This hierarchy of the

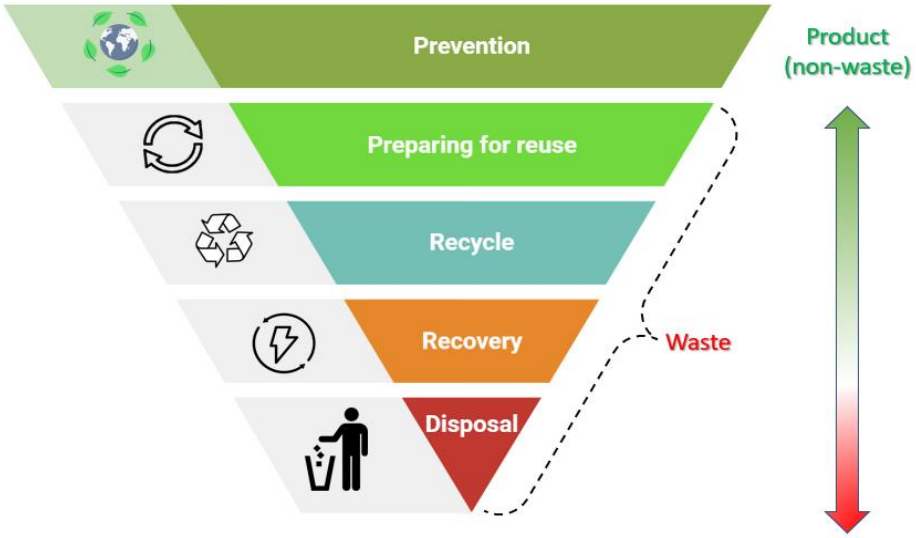

Figure 1. Waste hierarchy inspired by (European Commission, 2008)

European Commission indicates different methods of waste management, ranging from sustainable, i.e., prevention to least sustainable i.e., disposal.

Prevention is the most favourable option because it abolishes and reduces the toxicity and amount of waste. It also includes procedures that conserves the supply and inventory of resources (Zorpas & Lasaridi, 2013). Preparing for reuse (or simply reuse) is second-best solution after prevention because it can reduce the possibility of high level of waste generation and decouple economic growth from resource consumption simultaneously. (Rakhshan, Morel, Alaka, & Charef, 2020). Next comes recycling that lies below reuse in the waste hierarchy. Although recycling can divert resources from landfilling, it is regarded as an energy-intensive procedure that creates noticeable pressure on the environment, creating greenhouse and other sorts of emissions (Rakhshan et al., 2020). Disposal stays at the bottom of waste hierarchy because it is the last resort and least preferred option in waste management. It is a least sustainable method of waste management because this type of waste usually ends up as landfills and degrades the environment.

As mentioned in the previous paragraph Bodø municipality is ambitious to achieve circular solution and reuse is one of the most sustainable options that Bodø municipality should prioritize in their waste management in an efficient manner; for example, in the city planning around 'new city new airport' project (Bodø municipality, 2017 (b)). When the old military airport of Bodø is demolished and replaced with a new smart airport, what will happen to the construction waste? Can it be reused and recycled for further use as raw material? Reuse of construction materials[1] has a high potential to reduce the environmental as well as climate footprint connected to construction material extraction, processing, and production (European Commission, 2019). An added advantage of reuse is that the strategy can reduce construction costs and generate community benefits since it has the potential to create employment opportunities, training, and expertise for the citizens (European Commission, 2019). Norway is supporting the CE principles, wherein reuse is important to reduce resource consumption and create a more circular building sector (Netherlands Enterprise Agency, 2021). For instance, reuse is considered one of the ten most crucial measures and has an important place in the Norwegian real estate sector's roadmap for 2050 (Norway Green Building Council & Norway Real Estate, 2016). The report of the roadmap indicates that some of the construction wastes holds valuable resources and encourages the construction sectors to reuse the materials procured during reconstruction and demolition works. However, legislations and regulations regarding the reuse of construction materials in Norway are unclear, indicating their inefficiency in

[1] Reuse of construction materials/ reuse of building materials or components/ reuse of building waste/ reuse of construction waste: all have the same meaning

supporting the implementation of CE (Knoth, Fufa, & Seilskjær, 2022; Nordby, 2019). As of now, regulations and legislations are regarded as barriers that interrupt the sale and utilization of old building materials for new construction work. Hence, regulations and legislations need to be modernized to facilitate the accessibility of such materials to encourage reuse (Netherlands Enterprise Agency, 2021). Most of the construction companies demolish buildings and recycle the wastes instead of reusing them (Netherlands Enterprise Agency, 2021).

Currently Bodø municipality has two research and development projects for the so called "new city, new airport", namely 'CityLoops' and 'Circulus'. Circular economy principles are at the core of these projects. 'CityLoops' is a European Union (EU) funded research project that works for circular practices in several places of EU (Bodø Municipality, 2017 (c)). CityLoops aims to generate knowledge as well as develop methods and tools for mass handling of building wastes and bio-wastes in a more environment-friendly way (Bodø Municipality, 2017 (c)). The project 'Circulus', partly supported by Research Council of Norway and partner organizations, focuses on reusing and recycling 75% of concrete wastes and reducing 75% energy consumption in construction work by innovative methods and services (Bodø Municipality, 2019 (b), 2022).

Waste management is one of the challenges connected to the rapidly growing city. Large-scale construction works are part of the new city, new airport project. The climate footprint analysis of Bodø 2017 states that the construction and infrastructure sector in Bodø is liable for 42% of climate footprint including the entire activities of operation, maintenance, and transport of building material (Bodo Municipality, 2019 (a)).

The building materials from old construction should be managed by following the waste hierarchy. This indicates the need for proper planning to achieve the goals set by UN to create a smart sustainable city Bodø. The above-mentioned needs of Bodø and the projects that are given importance indicates that waste management is one of the challenges connected to this rapidly growing Arctic city. It is also clear that large-scale construction works are part of the new city, new airport project. Hence, to attach sustainability to construction works, building materials from old buildings should be managed by following the waste hierarchy. Proper planning to achieve the goals set by UN can also facilitate the creation of the ambitious smart sustainable city, Bodø. Hence, this thesis will shed light on current practices of reusing building materials in Bodø, implementation of the reuse by aligning with the vision of climate goals and

smart, sustainable city planning. Based on the empirical findings from the interviews with the relevant respondents, I will explain the current practice and the state-of-the-art of the reuse of construction waste Bodø city. I will also add information about the significance of reusing of building components to achieve climate goals and build a smart and sustainable city, the market for building material reuse in Bodø, success factors and opportunities for Bodø, consumer preferences and stakeholder motivation and national and local policies. Furthermore, by linking the responses (about the barriers) from the interviewees to the relevant information in published articles I will arrive at the main barriers that prevent the reuse of construction materials in Bodø city.

1.1 Motivation

During my master studies in 'Global Management', I came to know about different global challenges related to sustainability. Urban sustainability is one of the most significant challenges in this era of rapid urbanization. Urban areas are witnessing a tremendous exodus from other parts of the world. In addition, population explosion can be equated to increased need for foods, shelter, and other basic necessities. I also read about smart and sustainable city concepts which can be a fruitful solution for maintaining urban sustainability and sustainable development in any city. Furthermore, I attended two courses about CE and have understood the significance and relevance of CE implementation. I chose to study the relevance of CE by examining the reuse of building materials in Bodø because I want to contribute to the development of a city that has supported me for the last three years. In this way I could be part of Bodø municipality's endeavour and planning to create the so called smart sustainable city. I like this city and also know that Bodø has the possibility to be a smart sustainable city. I identified some discrepancies between their ambitions and executions and such differences can be regarded as hurdles while implementing the construction waste management of potential smart sustainable Bodø. For instance, many companies, hardly reuse any materials from the construction, and renovation works although I find that some of the waste materials have high reuse potential. I believe that Bodø should utilize such opportunities while trying to implement smart sustainable solutions. Hence, I wanted to investigate the current practice of reuse of building materials to nudge the system to adopt such approaches.

The development in Bodø holds an attainable potential to make the city smart and sustainable. The city board is planning to create a low emission society by 2050, utilizing circular economy/waste hierarchy principles. I believe that all the relevant sectors (e.g. construction and

manufacturing companies, architects and consultancy) must come forward and act together to make Bodø reach the set goals. The academia, especially Nord University, and other research bodies also need to play key roles to investigate various aspects of CE to gather specific, and data-oriented insights to guide the authorities and citizens to follow a sustainable path to create a future smart city. So far, there are not many studies that have investigated the potential, current situation, and practicality of reusing building materials in Bodø. There should have more study specifically on reuse of construction materials.

1.2 Research question

The aim of the thesis is to find out the answer to the following research question.

1. ***How does reuse of building materials contribute towards smart sustainable city, Bodø?***

To answer this main research question, I have formulated two sub-questions.

a. How is the current market of reusable building materials in Bodø?

b. What are the potential barriers that prevent the reuse of construction materials in Bodø?

As previously mentioned, this research provides knowledge about the practice of building material reuse in Bodø. It also enhances our understanding of the relevant market status also provides information about potential barriers for implementing the practice of building material reuse in this city. The insight from this thesis is intended to help Bodø municipality to take informed actions and to revisit their plannings to build a smart sustainable city.

In the next part (Chapter 2) of the thesis, I will discuss the relevant theoretical perspectives that guided me to answer my research question. Chapter 3 will represent the research methodology of my thesis. It will also provide information regarding the interviews with the representatives from manufacture and construction companies, architect and consultancy companies, public sector, waste management companies, research and development sector that are expected to take responsible actions to make the construction material use/reuse feasible in Bodø. In Chapter 4, I will present the empirical findings which are comprised of the laws and regulations regarding sale and utilization of building material in Norway and inferences from the interviewee answers regarding the significance of reuse of construction materials. I will also provide details of current market condition; stakeholders' and consumers' motivation to reuse construction materials; national, local, and administrative policies regarding reuse of construction materials; potential barriers that prevent the reuse of construction materials. In the

analytical chapter (Chapter 5), I will discuss and analyze the empirical findings based on relevant literatures and focus on the main barriers regarding reuse of construction material in Bodø. In the chapter conclusion, I will answer my research question and discuss practical implications as well as ideas for future research.

2. Theoretical Framework

Relevant literatures provide a framework to analyze empirical findings. In this chapter, I will present information from relevant published articles that helped me to answer the research question. First, I will describe the importance of waste reuse for smart sustainable city. Later, the potential of CE in making smart sustainable city through reuse of construction wastes will be explained. Then, I will discuss a viewpoint (organizational decoupling theory from institutional theory) to distinguish between organizational original practice and their formal rule setting. This will give insights to understand organizations' behaviors towards reuse of construction wastes.

2.1 Smart sustainable city

Cities that are densely populated that are considered as powerhouses of economic growth as they can drive the global economy when they adopt innovative tools to overcome their challenges (De Sherbinin, Schiller, & Pulsipher, 2007). In fact, cities contribute to the global GDP (80% of the global GDP from 3% of geographical land) and they consume 75% of natural resources and 80% of global energy supply and generate 60-80% of global greenhouse gases and 50% of global waste (García Fernández & Peek, 2020). Conventional cities are unsustainable because of their impacts on the environment, society and economy (García Fernández & Peek, 2020). Unsustainable use of energy supply, unplanned waste management, and inappropriate urban planning in rapidly growing city can lead to social inequality, community deprivation, resource depletion, toxic waste disposal, increased demand in transport, mobility, health and public safety (García Fernández & Peek, 2020). Hence, city planners and policy makers should take effective decisions to develop cities that offer a high-quality living for the inhabitants to ensure a sustainable and resilient future.

There is an urgent need to develop and functionalize a sophisticated method for urban planning. Such a paradigm for sustainable urbanization will help overcome the intractable challenges. 'Smart sustainable city' is introduced as a probable solution for the difficulties related to the rapid urbanization and environmental impacts of cities (Höjer & Wangel, 2015). Raspotnik et al. (2020) stated that smart sustainable city framework is the integration of two concepts (smart city and sustainable city), where sustainability and technological dependency coexist. Smart sustainable cities utilize information and communication technologies (ICT) as facilitator for ensuring sustainable development of cities that provide quality living and allow participatory governance (putting people in the centre) (Höjer & Wangel, 2015). One of the comprehensive

definitions of smart sustainable city is provided by United Nation Economic Commission of Europe (UNECE) and International Telecommunication Union (ITU). They have defined smart sustainable city as an innovative city that employs ICT along with other means to enhance the effectiveness of urban operations and services, competitiveness and the quality of life (ITU, 2015). At the same time this innovative city satisfies the demands of both present and future generations in terms of cultural, environmental, social and economic aspects (ITU, 2015). This definition identifies five main aspects (environment, governance, cultural, economic, and social) of smart sustainable city (Azadeh Dindarian, 2021). Pira (2021) also mentioned about four categories, i.e., environmental, socio-cultural, governance, and economics of smart sustainable city and significant indicators of these categories. Within the environmental aspect, Schipper and Silvius (2018) emphasized that smart sustainable city must be sustainable in terms of waste management, biodiversity, low emission as well as energy and resource use. Waste generation is one of the most significant indicators of the environmental category of smart sustainable city (Pira, 2021). This indicator refers to generation of waste from municipal and industrial activities, generation of hazardous wastes, and the waste management procedures such as reuse and recycle (Pira, 2021).

Construction sectors are liable for huge amount of waste creation and resource consumption, which are considered to have adverse effects on both environment and society (Lu & Yuan, 2011). Construction or building wastes are the dumped components/units/materials generated from various construction activities, for instance, land excavation, renovation of old buildings, new building construction, site clearance, road and highway construction, demolition activity and so on (Park & Tucker, 2017).

The thesis concentrates on reuse of construction waste as part of sustainable waste management, with a potential smart sustainable city in mind. We cannot mitigate the negative impact of construction only by increasing recycling rates because recycling processes themselves often generate wastes (Rose & Stegemann, 2018). Reuse of construction waste should be prioritized in construction waste management since reuse necessitates minimal processing prior to the replication of material for similar application, while being less resource and energy intensive than recycling (Hobbs & Adams, 2017; Rose & Stegemann, 2018).

2.2 Circular Economy (CE) and its importance to build a smart sustainable city

CE is defined as an alternative economic system that goes beyond the mainstream linear economy (Kirchherr, Reike, & Hekkert, 2017). It abolishes the term 'end of life', by adding reusing, recycling, and recovering material, from production and consumption processes (Kirchherr et al., 2017). The aim of CE practice is to ascertain the sustainable development goals that can bring benefits to micro (such as products, business companies, consumers), meso (for example: industrial park), and macro (for instance regional, city area, national) levels (Nikonorova, Imoniana, & Stankeviciene, 2020). CE practice is recommended to attain significant number of sustainable development goals and a comprehensive strategy to attain sustainable development targets (Schroeder, Anggraeni, & Weber, 2019; Shooshtarian, Maqsood, Caldera, & Ryley, 2022)

CE has the potential to bring economic productivity as it stimulates sharing economy, enabling a city territory to thrive in a sustainable manner. This will eventually decrease traffic congestion, reduce wastes and emission, decrease prices as well as advance business and growth, expertise, employment and quality life of the citizens (Ellen MacArthur Foundation, 2017). Since CE can reduce emissions through different approaches cities can mitigate the global climate change (Ellen MacArthur Foundation, 2017). Social equity, participation, collaboration, sharing, wellbeing, health safety of human beings are some of the social gains that CE brings (Ellen MacArthur Foundation, 2017; Nikonorova et al., 2020). CE model has strategic focus on its core to reframe and reorganise materials, gain greater resource efficiency by incorporating reuse, remanufacture, recycling (Shooshtarian et al., 2022).

The key tenet of CE is that waste reduction can create new source of value for a business organization (Shooshtarian et al., 2022). Implementation of CE principal in construction waste management has significant potential to reduce the negative impact on environment through efficient waste management and resource use (Purchase et al., 2021). Construction waste management should follow waste hierarchy guided by CE concepts (reduce, reuse, refurbish, recycling) which specifies the best environmental choice of waste management policy (Spišáková, Mandičák, Mésároš, & Špak, 2022). As mentioned previously, prevention, reuse, recycle, recovery and disposal are five levels of construction waste management strategies (Spišáková et al., 2022). This thesis study is about CE reuse in managing construction waste since reuse is considered as second best sustainable and efficient strategy that has high potential in construction sectors (Spišáková et al., 2022).

2.3 Reuse of construction waste as a phenomenon of CE

Waste from construction and demolition activities is the largest waste stream in EU (European Environment Agency, 2020). In 2018, there was a steady increase in construction and building waste in Europe, the value of which was approximately 1 billion tons (Eurostat, 2018). In 2020, Norway generated 2,135,747 tons of total waste from construction activities, of which demolition activities, renovation and maintenance work and new construction activities accounted for 46% , 24% and 30%, respectively (Statistisk Sentralbyrå, 2021). In 2020, building and construction sectors consumed 36% of global energy (United Nations Environment Programme, 2021). Furthermore, energy-related emissions of the global construction sector decreased from 39% to 37% during 2019-2020 (International Energy Egency, 2019; United Nations Environment Programme, 2021). This current decrease in energy-related emission is mostly because of Covid-19. Since a sector-wise decarbonization is limited, a further transformative long-term planning for emission reduction is necessary (United Nations Environment Programme, 2021). Construction sector is the major contributor of environmental degradation and pollution (Lu & Yuan, 2011). Therefore, construction sector has a great liability to play a key role in emission control, and to deal with the environmental problems and to reach global climate goals.

Global population increase will bring new consumption pattern including a necessity for more developmental activities, more exploitation of natural resources, challenges linked to health and safety, wellbeing, and environmental degradation (Munaro, Tavares, & Bragança, 2020). Furthermore, an increase in price of building raw materials and a huge amount of waste creation by construction sectors underpin the importance of utilization of construction resources more efficiently, emphasizing the need for finding alternative sources of materials and adopting CE (reduce, reuse, recycle) to attain sustainable consumption (Munaro et al., 2020).

Reuse of building and construction material is defined as using the same material more than once in construction activities, for instance, using door, steel, wooden shutters, glass from old to new construction purposes (Park & Tucker, 2017). According to waste hierarchy- ‘reuse’ is the second-best waste minimization method and is preferred to recycling (Rakhshan et al., 2020). Recycling of building materials is energy and resource intensive and create noticeable pressure on environment in different ways, for instance, by producing greenhouse gases and other emissions (Rakhshan et al., 2020). On the other hand, reusing building or construction components (beams, brick, concrete, columns, truss and so on) can reduce the negative impact on environment as it has a minimum requirement for processing and energy compared to

recycled materials (Park & Tucker, 2017; Rakhshan et al., 2020). A study on circular economy in the construction sector indicated that reusing of building components has the potential to decrease the resource consumption by 20% due to reduction in greenhouse gas emissions in Norway, i.e. by curbing the release of 900 000 tons CO_2 equivalents[2]/year (Høibye & Sand, 2018).

Construction waste management in European countries is mostly carried out by backfilling operation, and low grade recovery and low quality recycling are not credible to maintaining circularity in construction waste management (European Environment Agency, 2020). Reuse should be given more priority than recycling but in reality companies do not practice it (Hobbs & Adams, 2017). Considering recycle and reuse, which are important in CE, as complementary options in old building materials is a common misconception because they are competing choices for continuous use of resources (Hobbs & Adams, 2017).

Studies carried out by e.g., (Knoth et al., 2022; Nordby, 2019) pointed out significant opportunities, barriers and drivers of reuse of building materials in Norway. Collaboration and information sharing in value chain, in-depth knowledge about the quality of old construction materials, enhanced societal changes and regulation favouring reuse are significant drivers to stimulate building material reuse practice in Norway. In addition to these drivers, competence building through new pilot projects, collaboration with educational institutions to build knowledge and guidelines, establishing online and physical platform with information about used materials can have positive impact on building material reuse (Knoth et al., 2022; Nordby, 2019). Efficient technology, economic incentive for innovation, research and development of organizations, and understanding of the key benefits of reuse can enhance the reuse practice of building material in Norway (Knoth et al., 2022; Nordby, 2019). On the other hand, lack of financial support, lack of in-depth knowledge and experience about reuse practice, unsupported regulation to sale and utilize old building products are hinderances to reuse of construction materials in Norway (Knoth et al., 2022; Nordby, 2019). Furthermore, undeveloped market with lack of information, logistics, limited pilot projects to get experience, complexity in the value chain are some of the barriers in Norway that adversely affect reuse practice linked to construction materials (Knoth et al., 2022; Nordby, 2019).

[2] CO2 equivalent: A matrix measure for comparing the emission from various greenhouse gasses based on their global warming potential by transforming the quantity of other gasses into equivalent amount of carbon dioxide with same global warming potential (Eurostat, 2017).

The report of European Environment Agency(EEA), ‘’Waste Prevention in Europe, Policies Status and Trends in Reuse in 2017’’ mentioned about the challenges that interrupt the development and scope of reuse of building components and these challenges can be different based on local and national circumstances (European Environment Agency, 2018). According to the report, some of the key challenges are mismatch in quantity and quality, insufficient logistic facilities for heavy weight materials, lack of local facility for reclamation of used building materials, unwillingness to use the materials without certification of performance, origin, life span and efficiency of the material, health and safety risk in manual deconstruction (European Environment Agency, 2018). Inconsistent legislation and regulation with high requirements of certification and documentation that discourage the practice of reusing construction materials (Park & Tucker, 2017). The lack of environmental concern of stakeholders and the unwillingness of the consumers to reuse are critical barriers for the development of the reuse market and practice (Park & Tucker, 2017). A variety of sectorial, financial, and regulatory issues affecting the development of the reuse of building materials have been disclosed in studies (Dunant et al., 2017; Rakhshan et al., 2020). Many obstacles need to be overcome to make reuse of construction components predictable. However, it appears essential to solve the normative issues relating the laws and regulations for the reuse of building materials (Zatta, 2019).

2.4. Organizations’ Decoupling

This thesis aims to find out the current practice of building material reuse in Bodø seeks the answer for the main research question, “**How does reuse of building materials contribute towards smart sustainable city, Bodø?’’.** The previous concepts have explained how the circular economy principles and waste management can be theorized and used to answer the research question. It is also known that any type of organization needs to be socially mandated and legitimated by complying with societal expectations. When an organization claims to conform with this societal expectations, but only adopts them superficially in their real business operations, they decouple their action from their core structures (Boxenbaum & Jonsson, 2017). Decoupling is a phenomenon from institutional theory which describes how an organization maintains and creates gap between their formal structures/policies (expected transparency) which they adopt ceremonially and their actual business practices (preferred secrecy) (Meyer & Rowan, 1977). Institutional theory describes the processes and causes of organizational

actions, as well as behaviors and the impact of that behavior on the broader inter-organizational surroundings (Guth, 2016).

Reuse in waste management is an important imperative for sustainable waste management, as inferred from published articles. Reusing construction waste based on CE principles and waste hierarchy can be considered both as policy and action that is regulated and must be implemented. I find it useful to discuss decoupling as theoretical lenses to answer my research question.

Implementation of the practice of reuse of construction waste depends on the joint contribution of different organizations. But it is not always expected that all organizations will morally feel to start reuse of construction material for sustainable waste management and they will not accept policy according to institutional regulation. Also, it is not expected that their implemented policy will bring intended goals. Through two forms of decoupling (policy-practice and means-end) we can discuss why organizations fail to implement policy, and why they do not achieve intended success even though they implement external policy. When an organization adopts rationalized policy symbolically to conform to the institutional pressure and takes action according to its own choice (symbolic adoption), this situation is considered as traditional view of decoupling or policy-practice decoupling (Bromley & Powell, 2012). Organizations mainly decouple when they feel extreme coercive pressure to implement policy, when they distrust persons or actors who force to implement policy, when there is increase of homogeneity among organizations and when an organization is late mover in adopting a policy (Boxenbaum & Jonsson, 2017).

Policy practice decoupling prevails in an organization when institutional demand and organizational technical demand are vastly different (Meyer & Rowan, 1977). In Norway, reuse is in initial stage and it is not recognized as an established practice yet, and more importantly, construction waste management mostly depends on recycling and landfilling (Knoth et al., 2022). There is need for more pilot projects to get knowledge about policy and practice since reuse is considered with a conservative mindset (Knoth et al., 2022). So, organizations can hardly believe a new phenomenon of reuse of construction waste and organizations think that such actions may not create good stories and may not live up to their stakeholder's demand, and somehow can be risky. Lack of information about uncertain customers' needs is one of the most hindering barriers of circular economy (Tura et al., 2019). Organizations sometimes struggle to see beyond the established way (linear system) of doing things and hold a silo

mentality to implement new things (closed loop system) that causes barrier to enhance circular practices (Tura et al., 2019).

Organization decouples when policy is at advanced stage, implementation of a new practice requires resources and organization has weak capacity to implement it (Bromley & Powell, 2012). To implement reuse of building waste, organization should have financial, technical, intellectual capacity as well as risk taking mentality (Knoth et al., 2022). It is not expected and there is no guarantee that an organization has all these resources. Lack of financial fund, technical knowhow, information sharing, concrete organizational roadmap and system interrupts the start of circular economy activities in organizations (Tura et al., 2019). CE requires high up-front investment when organization plans to shift to CE-based practice and such an action creates financial barrier for organization (Grafström & Aasma, 2021). For instance, deconstruction before reusing is considered a labor intensive task that takes extra cost (Rakhshan et al., 2020). After deconstruction, old materials need to have logistic facility and also storage facility for proper maintenance which also requires extra financial capability (Rameezdeen, Chileshe, Hosseini, & Lehmann, 2016). While designing with old materials, it is important to have better planning, extra time and money (Dunant et al., 2017).

When a policy is not reinforced by the internal constituent of the organization and there is mismatch between organizational internal constituents and imposed goals by formal policy an organization decouples (Bromley & Powell, 2012). If organizations' different stakeholders, managements, employees, existing practices hold misconception about reuse building materials, it create barriers (Rakhshan et al., 2020). Tura et al. (2019) also points out if there exists an incompatibility in organizational existing practices and development targets, it creates barrier for the implementing of circular solution.

Because of the growing accountability, audit culture, increase of rationalized environment and institutional pressure in the present era, organizations can hardly ignore policy and hence, they try to implement the policy that was adopted before symbolically (Power, 1994). Sometimes, organizations shift to CE-compliant system from linear system to gain social legitimacy and to secure organizations' existence (Jain, Panda, & Choudhary, 2020). But not always organizations accomplish the intended goals when they implement policy. When there is tenuous link between application of policy by an organization and intended goal that brings out means and ends decoupling (Bromley & Powell, 2012). Means and ends decoupling horizontally stays inside the functional units of the organizations that can give the answer to the

question why an organization dedicates resources to apply a range of formal rules that have an opaque relationship with core goals (Bromley & Powell, 2012). When the consequence of an action is difficult to measure, the practice and outcome are highly opaque to identify ultimate result of policy implementation; in this scenario means versus end decoupling prevails (Bromley & Powell, 2012). The opaque field is considered a field with lack of knowledge, motivation, and attention that is surrounded with causal complexity, behavioral invisibility, and practice multiplicity (Wijen, 2014). Practice multiplicity, behavioral invisibility and causal complexity are recognized as compliance barriers (Wijen, 2014). A field is more opaque when three factors of compliance barriers exist (Wijen, 2014). Heterogenous practices in same field by heterogenous actors make organizations confused about practices' advantages, relevancy, and limitations (Wijen, 2014).

On the other hand, behavior invisibility creates lack of motivation among adopters and weaken organizations' willingness to comply with policies (Wijen, 2014). If there is lack of clear incentives and inspirations about circular economy practices, organizations fail to acknowledge its ultimate benefits (Tura et al., 2019). When the peer organizations start CE practices, it makes entrepreneurs motivated as they can feel secured and can recognize the benefits of implementing CE business and find relatedness with shared values (Rovanto & Finne, 2022). While organizations face ambiguity when they do not understand the complex practices they do not give due attention to the context and implement practices superficially (Wijen, 2014). Complex and overlapping regulations are liable to interrupt circular economy practice (Tura et al., 2019).

From the above discussion and relevant literatures, we can identify some broad factors that act as reasons behind the organizations' decoupling and they are summarized in Table 2.1.

Table 1. Factors compelling organizations for decoupling inspired by literature review (Bromley & Powell, 2012; Wijen, 2014)

Broad factors	Explanations
Institutional pressure	Extreme coercive pressure by institutions and government to push organization to adopt new practice (DiMaggio & Powell, 1983; Meyer & Rowan, 1977; Seidman, 1983)

Knowledge gap	Lack of understanding about the new practice and its actual benefits (Briscoe & Murphy, 2012; Bromley & Powell, 2012; Jiang & Bansal, 2003). Distrust about actions and knowledge gap for policy implementation (Boxenbaum & Jonsson, 2017),
Limited capacity	Policy is in advanced stage compared with organization's capability in terms of resource, infrastructure and expertise (Meyer & Rowan, 1977; Weick, 1976)
Lack of collaboration	Lack of willingness and reinforcement by organization's stakeholders, internal constituents (Bromley & Powell, 2012; Zajac & Westphal, 2004).
Ambiguity	Non-transparent fields having multitude of actors and factors create causal complexity, uncertainty results from complexity (Levy & Lichtenstein, 2012) Blurring difference between cause and effect, superficial adoption of policy (Wijen, 2014) Practice multiplicity accompanied by heterogenous routines of different actors (Santos & Eisenhardt, 2009) Imitating wrong and counterproductive practice (Terlaak & Gong, 2008) Incapability to evaluate the behavior of the actors, behavioral invisibility (Jiang & Bansal, 2003) Lack of motivation to comply with policy for behavioral visibility (Aravind & Christmann, 2011)

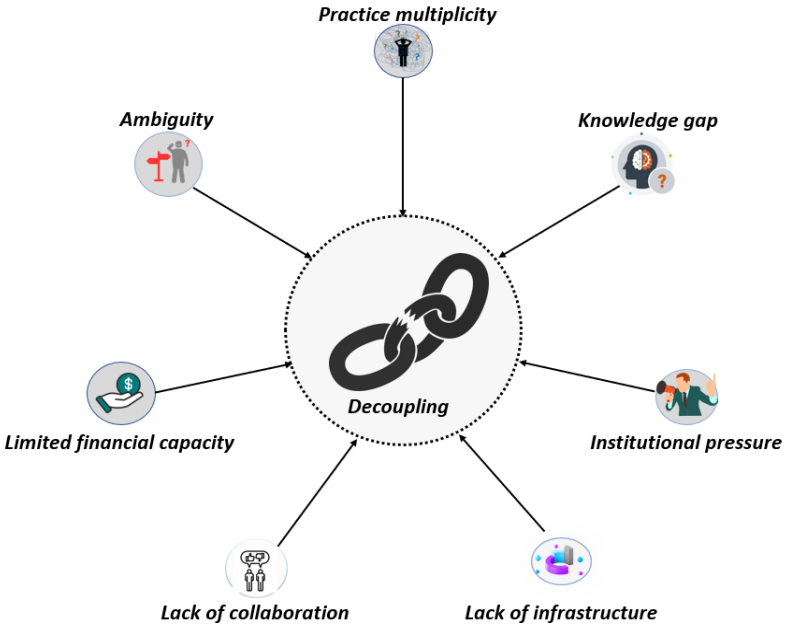

Figure 2. Factors compelling organizations for decoupling inspired by literature review (Bromley & Powell, 2012; Wijen, 2014)

2.5 Summary and research model

For this thesis, I gathered information from CE literature on waste management for smart sustainable city. Smart sustainable city promises to get environmental sustainability in general and sustainable waste management particularly (Esmaeilian et al., 2018). Reuse of construction waste guided by CE-inspired waste hierarchy of EU has huge potential to save energy, resource use and emission control recycling (Hobbs & Adams, 2017; Rose & Stegemann, 2018). But reuse of construction waste is obstructed by various types of barriers (Rakhshan et al., 2020). Among them, regulatory and legislative barriers are interrupting mostly and hence, they should be overcome first to enhance construction reuse (Zatta, 2019). In the case of Norway, besides a slew of other barriers, laws and regulations interrupt the sale and utilization of old materials (Knoth et al., 2022; Nordby, 2019). Rule makers such as EU generates policies related to CE reuse in waste management and rule takers like local community, organizations, citizens accept the policy and work accordingly. Institution is an amalgamation of the result of interplay between upward and downward causation (Schulz, Hjaltadóttir, & Hild, 2019). Institution is not only generated by coercive regulations and actual social practices of how a game is played, but at the same time, it also determines the social practices and creates impact on policy making and regulations (Schulz et al., 2019). So, implementation of a policy can be interrupted by how organizations practice and accept the formal rules. Like other barriers (financial, technological,

regulatory, and so on), lack of moral drive among the organizations to accept the policy and lack of understanding to implement policy aligned with goal can also create barrier in reuse of construction materials.

Research model for the study is illustrated (figure 3) below and will be used to answer the main research question **"How does reuse of building materials contribute towards smart sustainable city, Bodø?"**

Figure 3. Research model

3. Research Methodology

Research methodology is defined as a strategy which specifies how research will be conducted (Melnikovas, 2018). It refers to the philosophical assumptions which form the understanding of a research question and helps to select appropriate research method and ascertains the consistency between selected tools, technique and philosophical understanding in a research study (Melnikovas, 2018). For constructing the methodology of this thesis, I apply the theoretical concept of 'research onion' referred by Saunders, Lewis, Thornhill, and Alexandra (2019). Keeping this concept as basis, I will initiate this chapter with research philosophy considering philosophical approach that has been aligned with this research aim and purpose. Further, I will mention about research approach and research method. In research design I will inform about the preparation before collecting data, sampling and data collecting method that have been used in this study. Then, assessment to the quality of the data will be presented. Finally, I will go through the ethical consideration that is surrounded in this study.

3.1 Research Philosophy

Our individual perception of reality influences the way we gain knowledge and we take actions (Saunders et al., 2019). Research philosophy is defined as a set of beliefs which provide guidance about the design and execution of the research study and develop knowledge for a certain phenomenon. In all research studies researchers go either consciously or unconsciously through some assumptions (Crotty, 1998). These are assumptions for the reality that they encounter in research (ontological assumption), assumption for the acceptable knowledge for a particular phenomenon (epistemological assumption), and assumption for how their own personal value affects their research process (axiological assumption) (Crotty, 1998). These three assumptions help researchers understand the research question, how they choose method for research, and how they interpret their findings (Crotty, 1998). If these assumptions are consistent and well thought out it will generate a credible 'research philosophy' which allows researcher to undertake a coherent research project by choosing suitable method, strategy, techniques and procedure for data collection and analysis (Saunders et al., 2019). The philosophical position of this thesis is located under interpretivism as the thesis aims to create enhanced and interpretive understanding of the social context like how interpretivists do (Saunders et al., 2019). The ontological stance of interpretivist is described as, social reality and interpretivism of the researcher is through projection, interpretation and consciousness (Melnikovas, 2018) and objective existence of reality cannot be separated from subjective

understanding of it (Žukauskas, Vveinhardt, & Andriukaitienė, 2018). Epistemological aspect of interpretivism states that knowledge is abstract descriptions of meaning, derived from human experiences (Žukauskas et al., 2018). Axiology of interpretivism is ethics and ethical consideration as interpretivism considers value bound research, where interpretation by the researcher and researcher reflexive are key to the study (Saunders et al., 2019).

3.2 Research Approach

My research relies on abductive approach which is mentioned as systemic combining by Dubois and Gadde (2002). Systemic combining is a process where theoretical framework, empirical findings and case analysis evolve concurrently and from which new theories and direction are developed (Dubois & Gadde, 2002). Abductive research is applied in interpretivism to generate scientific description of social life by extracting the meaning and concepts used by social actors and the activities in which they are related and it finds out the reason rather than cause behind a situation (Malhotra, 2017). In abductive research approach data collection is applied to investigate a phenomenon and to recognize pattern and theme and to meet with the conceptual framework before testing the current theory (Saunders et al., 2019). In my thesis I have chosen an abductive research approach. Reuse of building waste is significant for decreasing virgin resource consumption and energy use and to get credible position in reduction of environmental footprint and emission reduction (Knoth et al., 2022) and CE promotes urban sustainability (Ellen MacArthur Foundation, 2017). I wish to investigate the phenomenon of current practice of reuse of building materials in Bodø city and its relevance and significance towards smart sustainable city and climate goals by analyzing the empirical findings and comparing and confronting them with existing theory and literature. I wanted to bring out the signposts and insights from analysis to provide this city, Bodø. I intend to provide new understandings, new way to refresh their practice of reuse of construction materials. Therefore, in my thesis I have chosen an abductive research approach.

3.3 Research Method

This thesis follows the qualitative research method. Qualitative method brings out and explores the deeper understanding of the real-world problem or phenomenon by collecting and analyzing the non-numerical data (e.g. text, video, audio record) (Creswell, 2012a). On the other hand, quantitative method provides generalized facts about a topic analyzing the numerical data (data

which can be expressed as number) and using mathematical and statistical tools (Creswell, 2012a). Whether one research will be carried out based on qualitative or quantitative method depends on the main research question, research design, preparatory work and the desired deliverable the researchers want to provide (Bluhm, Harman, Lee, & Mitchell, 2011). In many cases background literature determines the method of a research, in terms of qualitative or quantitative (Bluhm et al., 2011). Qualitative research is significant to perceive individual experiences through their active participation and to interpret their experiences (Bluhm et al., 2011). Qualitative method has unique ability to provide deeper understanding of the real world as it is structured, experienced, and interpreted by the people during their everyday life. It is hard to elucidate by closed question survey using quantitative method. This thesis aims to gather an in-depth understanding of the implementation and practice of building material reuse to make smart sustainable city, Bodø. Waste generation from the environmental category is one of the indicators of smart sustainable city and construction sector has a huge environmental footprint, indicating the need for building material reuse for emission control, efficient resource use and reduction in energy consumption in the present-day scenario of limited raw material availability.

I interviewed different actors who are closely related with this construction field and building material handling in Bodø city. This thesis wants to unfold this phenomenon (reuse of building material) regarding Bodø and based on the aim of this thesis I have chosen qualitative research method. The main research question of this thesis 'How does the reuse of building materials contribute towards smart sustainable city, Bodø?'- to find the answer to this question, I must go through the current practice of reuse of building material in Bodø, including the current market status of reusable building material management, the associated ongoing activities and potential barriers for implementing construction material reuse in Bodø city.

3.3.1 Case Study

For this thesis I have preferred case study where reuse of building material in Bodø city is a single case design. This case was taken for providing insight towards smart sustainable city Bodø. Case study research is more relevant when research question seeks for an in-depth and holistic explanation of any social phenomenon and aims for explaining (how/why) any contemporary circumstances (Yin, 2018). Single case study research is well suited when researcher aims to study on one single thing, group, or people from a group (Robert K. Yin, 2009). In-depth exploration of a subject can be performed in a single case study (Yin, 2018). Although findings from multiple case design is stronger and representative for generalization

(Yin, 2018), the findings of this thesis will contribute to the understanding of a single case 'the current practice of reuse of building materials' in case of making Bodø, smart sustainable. Findings from my thesis do not seek to generalize and interpret in a broader way to apply the conclusions for other smart sustainable city development. This thesis uses different literature sources, documents, reports and conducts interviews for gathering new information and understanding about the phenomenon, reuse of construction materials in Bodo city like single case study does (Yin, 2018).

3.4 Research design

Research design is a logical and systematic plan followed by researcher to reach a valid and credible conclusion of the research work (Yin, 2018). This design refers some major steps including, relevant data collection, analysis and allows researchers to give attention on selected research method and sets up their studies to fulfil the purpose of the research (Yin, 2018).

3.4.1 Preparation before collecting data

According to Mark Easterby, Smith & Richard, and Jackson (2021), the first task before collecting data is to determine the sampling strategy for perceiving the answers of potential participants for research and also the method for data collection. In this part I will discuss my chosen strategy for selecting participants and preparation regarding the chosen data collection method.

3.4.1.1 Sampling

Sampling is a process of picking out the subset of items from defined population for research (Guest, Namey, & Mitchell, 2013). The sampling unit can be people, group event, time, places from which the data is collected to find the answer of the main research question (Guest et al., 2013). Non-random selection of sample is required while doing qualitative research since the findings cannot be generalized for understanding a bigger issue (Yin, 2018). According to Collis & Hussey (2014) when generalization is not the goal of the study there are three methods that can be used for selecting non- random sample, these are, normal sampling, snowball sampling, judgmental/purposive sampling. Natural sampling involves the selection of sample from most available population that are convenient for a particular time (Collis & Hussey, 2014). In judgmental/purposive sampling technique, sample is selected based on researchers' own choices and gut feelings (Collis & Hussey, 2014). Snowball sampling includes experienced participants to understand the phenomenon which is being studied and then adds in further

participants who have gone through the similar experience for giving more information about the phenomenon (Collis & Hussey, 2014).

For conducting this research snowball sampling has been used. Snowball sampling is convenient when the desired participants for research study are hard to reach and are unknown to researchers (Parker, Scott, & Geddes, 2019).Researchers apply their social network to make preliminary link and the initial participants recommend will provide recommendations for choosing the next participants from whom researcher will get desired information (Parker et al., 2019). Snowball sampling begins with two steps, firstly, identifying the potential initial one or two subjects from the population for the targeted context, and these initial subjects are considered as source and seed for the research and later these initial subjects will be asked to recruit other relevant participants (Parker et al., 2019). This process is analogous to snowball rolling on the hill and continues until data saturation (Parker et al., 2019). As this thesis wants to know the current practice of reuse of building materials, it is important to reach the participants from different organizations who are involved in CE related activities. The participants working on circular solution in Bodø city are familiar with this concept. Considering this, I decided to adopt snowball sampling (Figure 4) which I thought will be

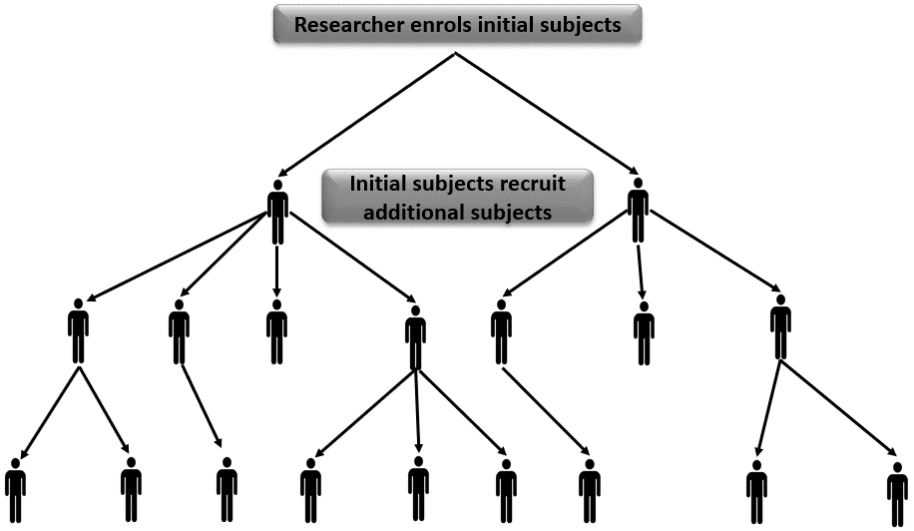

Figure 4. Snowball sampling method developed based on the concept described in Parker et al. (2019)

convenient for collecting data. I started to contact relevant persons to select as sample seeds as well as initial subjects who are expert of the targeted context. I select initial subjects from waste management company, public sector and construction and manufacturing company and further recommendation comes from initial responded subjects to reach more informants.

3.4.1.2 Semi-structured interview

To collect the primary data, I preferred to interview selected participants. Interview can be conducted in a structured, semi-structured, and unstructured way. But I have chosen semi-structured interview for this thesis so that the informants can express their perceptions and experiences frankly and freely. Compared with structured interview, semi-structured interview is better for generating knowledge through dialogues because it allows the interviewee much more freedom and flexibility in their conversation and permits to add follow-up questions from different angles of significant factors relating the research and conversation (Svend Brinkmann, 2011). The follow-up questions can bring out the insights which were not predicted before (Bell, Bryman, & Harley, 2019). Semi-structured interviews are not bound in any preset interview guide like structured interview but are guided by interview topic and requisite framework relating to research question (Bell et al., 2019). Since semi-structured interview allows flexibility to the informants in conversations, it brings a comprehensive data collection (Bell et al., 2019). Unstructured Interview is non-directive and sometimes longer discussion makes data analysis challenging (Doody & Noonan, 2013). It is a difficult task for a novice researcher since it has the possibility to create researcher bias and complexity while inappropriate questions are asked by the researcher and participants explain irrelevant issues (Doody & Noonan, 2013). I am an infant researcher, so I didn't want to take that risk.

I introduced myself and explained details about my focus area of the thesis to the interviewees. I also explained the topic and interview questions before conducting interview; this helped me to inform the participants what they can expect during the interview so that the participants can get ideas and time to think before responding. I also made clear to every participant about how their data will be applied and how their anonymity will be secured. I also specified the duration of the interview and assured them that they could avail their genuine right to withdraw their information any time without any reason. For choosing the interview schedule I always prioritized their convenience and flexibility.

3.4.1.3 Literature search and secondary data

Relevant literature provides the understanding about previous studies regarding the research topic and these information helps to identify the source of the data as reference and unique insight into the research (Saunders et al., 2019). Researcher gets primary data from direct observation such as, interview, audio/video records, survey and so on while secondary data or secondhand information is the information that is available in various report, publications and statistics (Yin, 2018). I did general google search for getting information for previous research

regarding reuse of construction materials, EU policies, rules and regulation regarding waste management, smart sustainable city planning and CE for climate goals and sustainability. Online academic database like Oria from Nord University and google scholar are used for getting important articles. I acquired primary data for conducting in-depth interview with the different participants.

3.4.2 Conducting Interview and data collection

Empirical data collection was done from the first of June to first of October by conducting semi-structured interviews. It took bit longer time to reach participants because maximum participants were on summer holidays until August. Interviews were conducted in person and online or by telephone. Though I preferred face to face interview some of the participants chose online interview via Microsoft Teams as they stayed out of Bodø at the time of interview and some participants decided online based on their conveniences. One participant wanted to join to talk over telephone. I have taken 18 interviews for this thesis. As this thesis follows snowball sampling the participants are selected based on their involvement with construction sector of Bodø city. I divided participants into 6 groups, which are, research and development(R&D) construction and manufacture companies (C&M), public sector (Pub), waste management company (WMC), consultancy and architect (A&C), forerunner private organization (FPO) representing business sport company with circular project and social company with circular business. The participants list, and interview information details are presented in following table 2.

Table 2. List of participants selected for the interview.

Participant groups	Respondent Code	Respondent from	Interview Date (2022)	Interview run time	Interview record method	Interview communication type
Public sectors	Pub1	Public research project	24th June	54 minutes	Audio recorded by phone	Microsoft Teams
	Pub2		17th Aug	45 minutes		In person
	Pub3	Public sector building department	7th Sep	50 minutes		In person
	Pub4	Public research project	3rd Oct	55 minutes		Microsoft Teams
Waste management companies	WMC1	Environmental advisory unit	26th July	45 minutes		Microsoft Teams

	WMC2	Project development	26th Sep	50 minutes		In person
Research and Development sectors	R&D1	Mapping of construction material project	24th Aug	48 minutes		In person
	R&D2	Circular solution in construction material research project	19th Sep	24 minutes		Microsoft Teams
	R&D3	Reuse-Recycling construction lab	19th Sep	55 minutes		Microsoft Teams
	R&D4	Reuse-Recycling construction Lab	3rd Oct	51 minutes		Microsoft Teams
Architect and consultancy firms	A&C1	Private Architect company (involved in circular solution)	2nd Sep	57 minutes		Telephone
	A&C2		5th Sep	45 minutes		Microsoft Teams
	A&C3		12th Sep	50 minutes		Microsoft Teams
	A&C4		22nd Sep	48minutes		In person
Forerunner Private organizations	FPO1	Social sports organization (aims for circular solution)	5th Sep	1hour		In person
	FPO2	Private circular business company	19th Sep	50 minutes		Microsoft Teams
Construction and manufacturer companies	C&M1	Private manufacturer company (involved in circular solution)	13th July	1 hour		Microsoft Teams

	C&M2	Private building company (eager to change in circular solution)	14th Sep	45minutes		Microsoft Teams

3.4.3 Validity and reliability

Validity refers to the suitability and appropriateness of the method that is employed in research, the correctness of the result that is analyzed and the generalizability of the outcome (Saunders, Lewis, & Thornhill, 2012).

Validity can be split into two, external validity and internal validity (Bell et al., 2019). Internal validity defines how extent research conclusion represent empirical findings (Bell et al., 2019). This was done by objectively reviewing data and then conclusion is added. Although I selected interview subjects and interview questions by gathering ideas from reading relevant literature and different CE reports of Bodø municipality, I asked the interview questions what I thought and believed that could focus on my main research question. To ascertain the objectivity, I concentrated on interpreting respondents' response rather than the emotion expressed by the interview subject. I also provided them with the interview guide (Appendix 1) at least one week before the interview, so that they can prepare themselves. During every interview I took notes but to get rid of misconceptions in transcribed notes, I approached respondents and got them corrected. External validity defines how much research conclusion is suitable for applying in social environment (Bell et al., 2019). Moving towards significant explanation and clarifying questions and adding follow-up questions to explore further are two significant approaches for test validity and authenticity during data collection.

Snowball sampling is a non-random sampling that has inability to determine how the study sample reflects the target population. Finding from the snowball sampling has limitation to hold generalizability (Raifman, DeVost, Digitale, Chen, & Morris, 2022). The purpose of the qualitative research is not to generalize the population rather to advance the in-depth knowledge and exploration about a certain phenomenon (Creswell, 2012b; Robert, 2008). I use snowball sampling for qualitative research. Through this thesis I strive to explore the topic, reuse of construction waste in Bodø when this city is going to be smart sustainable in the near future. I never demand that the finding is generalized for all other cities, but I described all the empirical findings that might be helpful for the reader to connect with their perceptions and studies.

Additional interview should be conducted until data saturation is reached (Saunders et al., 2012). I conducted total 18 interviews for my thesis. The number of interviews and the informants' selection process make me confident that this thesis holds high validity. Sample diversity is expected in qualitative research (Kirchherr & Charles, 2018). I did pre-study about reuse of construction waste, its barrier, the related actors of this field by reading literature, and then I thought about actors of Bodø. The best defense for the lacking to sample diversity in snowball sampling is to create diversity with sample seed as much as possible (Morgan, 2008). After discussing with my supervisor, I contacted with different responsible persons who are working with CE in this city and perceived their idea to select sample seeds for my thesis. Bodø is a small city, and hence first I selected sample seed from three different sectors such as, public sector, waste management company and manufacturing company and gradually increased the number from their suggestion.

3.5 Ethical considerations

Ethical issues in research are some of the genres or standard of behavior that should be followed by the researchers to protect the rights of developing research strategy and to make a trusted relationship with the respondents (Saunders et al., 2012). Ethical issues should be maintained throughout a research work (Saunders et al., 2012). These can be privacy, respect, anonymity, fairness, accountability, voluntary participation as respondent, right to withdraw information, safety, data management compliance, responsibility in data analysis and so on (Saunders et al., 2012). As a researcher we should adhere to the ethical rules. Having respect on ethical issues I did report on Norwegian Centre for Research Data (NSD) for approval of this research where I clarified how I will use the personal data and privacy. My research project was approved on 25th March 2022 (Appendix 2). Personal data act requires participants consent as mentioned in general data protection regulation in Norway (Norwegian Data Protection Authority, 2018). It is regarded that informed consent is keystone to ethical consideration of research. Researcher should get informed consent from the participant where they will sign and allow researchers to access their personal data and it specifies that participants are well informed about their right and privacy issues. It should be informed that; their participation is voluntary, and they can withdraw their information at any time without any reason. I got consent form with signed consent from each participant before the interview. A sample of consent form is provided as Appendix 3. I also specified participants' rights and informed how their confidentiality and anonymity will be maintained. As data will be only used for my master thesis, Nord university

business school is responsible for this data, and result can be used as an insight for Bodø city's smart sustainable city planning.

4. Empirical Findings

In this chapter, I will present the empirical findings to find out the answer to the main research question ‘‘**How does reuse of building materials contribute towards smart sustainable city, Bodø**’’. The laws and regulations in Norway regarding sale and utilization of reusable building materials will be discussed as well. The findings from interviews are described around the following aspects, (4.1) significance of CE reuse for potential smart sustainable city Bodø, (4.2) market status and availability of building materials right now, (4.3) consumer preference and stakeholder interest, (4.4) national and local policy, (4.5) success factors, potentiality, and opportunities, (4.6) potential barriers, and (4.7) way forward.

4.0 Regulations and laws[3] in Norway related to reuse of construction waste

Laws and regulations for selling and using of reusable building materials are determined by Norwegian Building Authority (DiBK). They are the main agency for executing building policy that stays under the ministry of local government and regional development of Norway (Regjeringen.no). The focus of DiBK is to ascertain safe and resilient building by implementing effective regulations. DiBK has given guidelines for selling reuse building materials (Direktoratet for Byggkvalitet, 2021b). Guidelines discloses the requirements and documents that are necessary before selling reuse products. There are two sets of regulations in the framework of DiBK that must be met (Direktoratet for Byggkvalitet, 2021b).

First set of regulations for reusable materials can be found in the documentation of construction products (DOK). It requires the characteristics of the building product that are sold and given away. Documentation for old materials for example, their origin or certification were difficult to obtain as it was not made with a view to reuse further. DOK demands European construction production regulation (EU nr 305/2011) as construction product regulation in Norway follows European construction product regulation (Direktoratet for Byggkvalitet, 2021a).

The second set of regulations ask for technical requirements of building or construction (TEK17). TEK17 requires the documentation about the quality of the product to ensure the functionality before incorporating it in a construction work (Direktoratet for Byggkvalitet, 2017). It is applicable for all the products regardless of whether it is new or old and old products from outside of the construction site or from inside (Direktoratet for Byggkvalitet, 2017).

[3] Here I describe only DOK (documentation of construction products) and TEK17 (technical requirements of building or construction), because these were the only elements found in the responses of the interviewees.

However, since last July 2022 changes have been incorporated into these regulations to enhance the market of reusable materials and circular economy practice in Norway (Ministry of Local Government and Districts, 2022). From July 2022, the quality and safety of the product was introduced in TEK17 (Ministry of Local Government and Districts, 2022). It is compulsory to meet the standards stipulated in TEK 17 for reuse of building products regardless of its sources. Before July 2022, the reuse of materials that were generated from outside the construction site or from the existing construction site were re-certified by DOK requirements. But now sellers need not adhere to certain regulations in the DOK when they give away building materials like steel, windows or concrete materials (Ministry of Local Government and Districts, 2022). Reuse of construction materials needs to meet only TEK17 (Ministry of Local Government and Districts, 2022).

It is now the responsibility of the new project group and the retailers (from second value chain) to meet TEK17 while they employ reusable materials in construction (Ministry of Local Government and Districts, 2022). Another change has come in TEK17 requirements that will possibly drive the reuse practice of construction waste in Norway. Change is in §9-7 of TEK 17 that informs that while doing big renovation and demolition work in residential buildings or office buildings, it is required to map the information of reusable construction materials in the form of a report (Direktoratet for Byggkvalitet, 2022). The guidelines are also mentioned in §9-7 of TEK 17 about the process of reuse mapping (Direktoratet for Byggkvalitet, 2022).

4.1 Significance of construction material reuse for the potential smart sustainable city

The empirical findings on reuse of construction waste and its significance in potential smart sustainable city, Bodø show that informants are familiar with CE practices for waste management in construction sectors and CE based waste hierarchy by EU. Definitions of reuse of construction waste that came out from most of the respondents' explanations were similar. Many of the respondents agree to *''Reuse is to take parts, then reuse these parts as they meant to be used like last time how were they used*''. In addition to this, informants Pub1 and Pub2 agree that reusing building or construction materials is pretty much similar with repurposing, and they hope that the construction companies elevate the quality of the reusable materials compared to their previous status. While defining reuse of construction waste informants Pub3 points out, *''my dream scenario about reuse is while making building we should keep in mind that it should be able to take apart again and we reuse materials''*. Informant A&C4 thinks

reuse is not always to dismantle building structure but renovating one building can be one way of reuse of building materials whereas informants R&D2 thinks renovating one building does not mean reuse of building materials but is refurbishing. To informant A&C3 reusing one whole building is easier option than building materials reusing. WMC2 emphasizes on changing the perception about reuse as waste. According to WMC2, reuse of construction waste is to find out the resource value of each piece of the materials, not to recognize old materials as waste.

While talking about the ambition of Bodø on smart sustainable city as well as the city's environment and climate goals, most of the informants agree and describe the significance of circular reuse in construction waste management to make smart sustainable Bodø. Participants think reuse in construction waste can contribute to Bodø's mission for smart sustainable city as well as environmental and climate goals since reuse is a less energy and resource intensive procedure which helps to reduce emissions. Most of the participants recognize emission reduction is one of the greatest strategies to reach climate goals and make the city smart sustainable.

Respondents also follow waste hierarchy in construction waste management. In their works, they prioritize reuse before recycling. Pub1 thinks buying new materials, use and later disposal are not the logical options when we consider environmental footprint, and reuse of building materials can be an effective option. Pub1 emphasizes, "*we have focus to bring reuse in higher place''*. Respondent, Pub4 says that reuse in construction materials can bring benefits for society as reusing can make new city as a place of culture and history when reusing old airport runway. Pub2 points out ''*being smart sustainable means not only something that is environmentally friendly but something that can sustain, adapt, and can bring change''.* Pub2 mentions to make a system that can be smooth as much as possible and can create change for today and tomorrow.

Participants think it has become a bit obvious to reuse building materials and to build building with longer life span with a view, to create value for the society and environment, not only for moral obligation, but also for financial benefits. Informant WCM2 informs we need to increase the reuse for our sustainable future. WCM2 shares the thoughts, "*it is more important to do things more than we say, for our generation and for reaching the vision what we hold for our city, and most importantly, we should do reuse to make change, we cannot live as the way we do''*. C&M1 adds, it is bit obvious to reuse building materials from the obligation for our environment and society and to save high logistic cost as Bodø depends on import of materials

from outside. C&M1 shares their ongoing research and development works on reuse of concrete and they will start pilot testing very soon. Another participant, C&M2, from leading construction company of Bodø also think that by reuse we can save our money and environment. C&M2 shares another thought*, "we should not do anything from our intention of greenwashing, but we must do it as we should participate on it''.*

The responses from the interviews show that most of the informants believe that reuse has positive impact for the city's sustainability aspect. FPO2 has great idea about circular business. FPO2 emphasizes that reuse of building materials brings benefits not only for environment, but also for society and community. *"People can put their money to local carpenters, entrepreneurs, can create local labor and job as well''*- (FPO2). FPO1 points out that when one city wants to be smart sustainable there should practice the reuse of building materials. FPO2's intention is to reuse building materials for developing new business, and this creates positive aspect for the economy.

When I asked about the significance of reuse in construction waste to respondents from research and development sectors, R&D1 is doubtful if it should be considered first because it is not clear if the process of reusing of materials will emit less than the process of use of the virgin materials, but in terms of reducing overall virgin materials use, reuse of building materials can be beneficial. "*It is not obvious and not clear yet that reuse of building materials can decrease green-house emission''*—participant, R&D1. R&D4 knows only environmental benefits of reuse of construction waste but is not that aware of other benefits for smart sustainable city. A&C3 shares the thought that when we build something new, we will use new materials because it is the reason why we are building something. A&C3 says that when we are making a new growing city like Bodø, we need more buildings, but if the building materials is good enough, we can reuse. "*But who will take care of the old bricks and wait for reusing it''*— informant A&C3.

When discussing the contribution of the construction sector to attain climate goal and sustainability of the city Bodø, respondents from public sectors agreed that reuse probably can be the most important improvement potential for the construction sector. But it is also important to make the construction sectors' actors understand about profitable business that reuse can bring for them by providing monetary incentives and circular public procurement. Participants think that construction companies do care about environmental benefits, but before that they care more about their financial benefits. Pub1 says, *"we need to make them realized that it is*

profitable''. R&D3 thinks that some construction companies in Bodø are joining to the emission control and sustainable activities because they think that if they don't join in this mission, probably their company will not exist after 50 years. R&D3 shares, *"but at the end of the day of course they think what is for them, they need certainty of profitable business''*. Similar thinking has come from participant, Pub3. Pub3 also thinks green and environmentally friendly construction sector is important for company's existence in the near future. A&C1 suggests that the construction companies should try to accumulate materials from local area, they should not import it from outside like how Norway imports virgin materials from different places. Most of the participants think construction companies have great role to play and should endeavor to contribute to environmental, climate goal and city's sustainability. Most of the participants also think that construction sector should give importance to reuse to reduce their environmental footprint, but at the same time, this sector should have the certainty about the financial benefits of reuse and confidence about long-term profitable business.

4.2 Market status and materials availability

While talking about reuse materials market in Bodø, availability and information of the reclaimed materials, most of the participants say reusable materials are not that much available in Bodø, and there is no established market here. When the military airport will be demolished, and new airport will be built old materials will be available for further use. R&D1 thinks, *"it is significant to have enough availability of the materials, knowledge and information about those materials, and an established marketplace''.* Participants mention reuse of construction waste in Bodø is in the very beginning phase, but Bodø has enough possibility to go further. A&C1 puts focus on the necessity of the established market in Bodø. A&C1 shares the thought *"in reuse project, as architect we must have materials while we start a project, we need materials available, and on the other side supplier cannot wait for long time just to store it''*. A&C1 also mentioned about their joint endeavor with a leading waste management company about categorization of reuse materials and when they started searching online platforms found that online websites for reusable building materials are not yet efficient in Norway. Among all websites A&C1 recommends Rehub.no has as strong vision for materials reusing. A&C4 and A&C2 think Bodø has enough materials to start reusable materials in construction, but Bodø needs a system right now, for instance, storage, market, information of old materials, good collaboration. FPO2 adds *"we believe that the market is here, but it needs to be developed further''.* WMC2 says, *"we need an overall system here for reuse of building materials, not*

only projects, projects are important, but when there is overall system, it becomes for always not only for certain time period''. Pub3 indicates that they had plans to sell and display building materials along with one private organization in Bodø and they started a physical platform, but it did not work because of the lack of enthusiasm from the customers. Perhaps this company can be closed within the year.

When I asked about maintenance and certainty of the quality of the construction structures made from reusable materials compared to new materials, A&C4 informs that as architect they decide the materials quality based on attractive design, product status (structural quality) and functionality whereas maintaining functionality is a big question. A&C4 thinks, *''if it is about cottage they can give guarantee of the quality, we can arrange it but if the project is to make hospital that is out of question, it is not possible''*. R&D2 thinks that the quality of the building materials that were in accordance with the standards of 50 years ago cannot comply with the quality of this modern time, for example windows from a building that is 50 years old cannot comply with the green change. R&D2 mentions that green change requires that the buildings are made by satisfying low emission or zero emission. R&D2 says that we can achieve this by using a sufficient heating system that dissipates less heat. R&D2 shares the thought *''the window that was made by the standard of according to 50years old cannot be the same quality what we need for today''*. RD2 also adds, in the case of building garage, where there is no need for heating, reusable materials are applicable. A&C3 is also of the same opinion. C&M1 informs that they are doing some research and development works and they are hiring eligible employees to understand how one could ensure the quality of the reusable materials quality because it is not clear to them yet.

When I asked about the easiest and most potential materials for reuse, some participants gave examples with confidence, but some others said directly that they don't have any idea about this. Most of them who answered mentioned about wood. They think wood is the cheapest and available materials and can be transformed and shaped in any way they want. A participant from a manufacturing company, C&M1 indicated that concrete is the most potential and easiest materials to reuse and was of opinion that wood cannot be a replacement for concrete and cutting trees are unsustainable. On the other hand, A&C4 thinks that Northern Norway has a vast area of forests with many huge trees, and hence, cutting trees will not have a bad impact. R&D3 points out the advantage of bricks compared to concrete "*it is brick because there's no iron, in concrete, there is iron that will rust, sooner or later, the carbonization will get emerged, then we need to use iron rebar for reuse, but the brick has no deterioration mechanism that*

goes on overtime, I can pick up a brick that is 500 years old and it's still the same brick''. While A&C3 considers red brick wall as the easiest materials to reuse as it is easy to split into different pieces, R&D4 is of opinion that steel can be reused without facing challenges because the documentation of its technical standard is not time-consuming but in the case of concrete, documentation is not easy because of its structural properties such as its durability and ability to take load.

4.3 Consumer preferences and stakeholder's motivation

When I asked about the factors that influence consumer preferences, most of the participants indicated price, attractive design, quality and functionality of the materials and consumers' perception and awareness on participation in environment and sustainability mission of the city. A&C1 mentions a consumer should have clear concept about reuse materials and its benefits. C&M1 says *"reuse should be done in a way that people want to have it''.* WMC2 mentions, *"reuse should not be looked like trash''.* Informants FPO2 and WMC2 prioritize idealism and the feeling of having the ownership to practice sustainability. These two are important from a consumer's viewpoint and it is clear that this moral internal drive is not a common behavior. Pub2 thinks that recognizing a citizen who nourishes circular construction reuse can be rewarded to inspire other consumers. But A&C3 thinks it is challenging to convince citizens in Norway because of their high income. This participant was not sure if the authorities can succeed in establishing circular economy in Norway because people here get money when they don't have job. He thinks that may be this is possible in a country where the salary is not high enough for them to not follow a circular economy. A&C3 again shares another thought *"maybe they can think about reuse while making garage but not for cozy apartment, why should they go for reuse, they have enough money''. Pub4 points out, "it is important to tell story to make consumers concerned about its significance for global climate change, make them believed but it is also important to find out best waste infrastructure and waste sorting solution to get highest waste value''.* Participants are also hopeful that changes are coming in Bodø, and our future generation (future potential citizens of Bodø) are in a positive mindset about sustainability practice.

When I asked about motivating factors to the stakeholders, WMC2 pointed out, "*Bodø municipality should be good customer to purchase CE related and emission free service from stakeholders and make the systemic changes and development to motivate stakeholders''.* FPO1 mentioned that they have gained lot of attention from citizens in Bodø as it is a social sports

organization. Hence, they want to utilize the attention that their players receive from the people to create a positive attitude towards a sustainable future, and this is their motivation for joining circular solution. C&M1 says, "*we take care of our produced materials from our emotional liability, liability for society and environment''*. Most of the participants think that more projects, financial incentives, certainty for the profitable business can be motivation for stakeholders. A&C4 says, *''money is our religion in this capitalist world''.*

4.4 National and local policy and support

Most of the respondents do not have close relation to the policies and regulations, however, some of them recognize that it is an essential instrument for the CE development. Mostly they have vague concept about unsupported behavior of regulations and legislation, and they can hardly specify which exact documentation and requirement is not supporting enough for reuse of construction wastes. According to informant Pub3, regulations and laws need to be a little bit more ambitious and bit more stimulating to accomplish the climate goals set within the Paris agreement. Pub4 mentions, "*TEK17 that does not set requirements for re-use mapping for reuse in the building so that's a new requirement last year so that's good yeah but as I say before some of the national strategy is that we want to implement in Bodø but sometimes it's difficult as there is a gap between the wish of national and the requirements today so it takes time to change''.* FPO1 says, *"I don't know that much about national policy, I know TEK17 is strict regulation for reusing building materials, but not that much''.* A&C3 also talks about TEK17 that is creating complexity after July 2022 because it is the responsibility of the buyers to ascertain quality. A&C3 shares the thought, "*but who will take this responsibility, Bodø municipality need to think''*. Pub2 informed about recent changes in regulation and consider it as a positive sign for reuse.

To discuss Bodø municipality's way of execution and status about reuse of building materials Pub3 mentions that they should move slowly in some cases as they don't have experience. Pub3 says, *"although I would like to see things done within the hour or within the year, but some things just have to have a paradigm, you have to build some experience, you have to see how it works out and how to correct your path*''.

While talking about national and local administrative policy, C&M1 thinks that there is a gap between the endeavors of politicians and top-level management of the country, about circularity. C&M1 thinks that although Bodø municipality has aims, skill and knowledgeable

working force, they lack collaboration with construction companies. C&M1 says, *"I think they don't have good collaboration with construction industries for instance, I have very little contact with them''.* C&M1 also mentions*, "sometimes Bodø municipality doesn't understand who their actual partners are, who really want to work for this city's mission' and they don't admire their work''.* Pub2 thinks, *"Bodø municipality is open to help all others, but they cannot treat one or two company with specially, and this is not possible''.* FPO1 thinks, *"municipality has passion for circular economy practice, they would have been better, but they don't have much money access''.* But most of the participants believe that Bodø municipality knows what their ambitions are and has many knowledgeable workers who know what to do, but it seems that there is a need for more systematic action and good financial capacity. FPO2 says that Bodø municipality gave enough support and was the buyer of their company of sustainable practice. WMC2 replies, *"Bodø municipality don't know what their businesses in their area do, also what companies they own, they don't know what they have to offer'',* or as *A*&C3 points out, *"I feel afraid thinking that, Bodø municipality has such high ambition about reuse of building materials without knowing the source of materials''.*

4.5 Success factors, potentiality, and opportunities

While commenting about success factor and opportunity of building materials reuse in Bodø, most of the informants think that Bodø has enough potential to reuse building materials. Bodø municipality is into it, they have ambitions, planning and research and development projects; each one of these are a type of success factor. While creating new city new airport and Bodø Storstue, the projects will create new opportunities for entrepreneurs and will develop the culture, practice and mindset of citizens and other stakeholders in a way to reuse construction materials. A&C1 shared opinion about the reuse week, 'Gjenbruksuka'; this communication platform is arranged by Bodø municipality and is an important initiative. However, A&C1 criticizes the initiative, *"It is not enough, they should arrange reuse storage''.*

To mention about success factors, FPO1 think, *"in the big city of the world, like at London, building materials can be collected within 24hours, but in Bodø, it is not possible, this challenge can be a success factor for materials reusing if there is good communication between different stakeholders, companies of Bodø, it will be possible to exchange reuse materials in different parts of the city".*

As Bodø mostly depends on imported building materials, participants think that it is an opportunity to utilize existing materials, but it is not possible to make a new growing city with only reusable materials. Pub3 narrated a success story: in one of their projects the municipality motivated some entrepreneurs to give away or sell windows from an old building and not to throw away valuable items. A&C3 mentions, "*very handful number of actors in Bodø need to bring together to make reuse successful as it is little city, so this is an opportunity for Bodø''.*

4.6 Potential Barriers

When discussing the potential barriers of reuse of construction waste, most of the representatives of public sector think legislation and regulations as barriers that hinder the reuse practice. Pub1 points out, "*in legislation, we need to think the old materials as waste and these wastes need to be treated by waste management facility, we cannot store these within storage facility, it is time consuming''.* Pub4 thinks TEK17 does not set reuse mapping requirement. Another participant from public sector Pub2 gave information about both changes in regulations related to selling of building materials and reuse mapping before demolishing buildings and indicated that these will have positive impacts on reuse of construction materials. R&D3 mentions that though there have been some changes, documentation is time consuming and is another big barrier, and the new regulation allows to use 20%/30%/40% in the case of reusable concrete. R&D3 says, "*I know we can reuse it 100%, my research and experience say I can make the concrete prescription with the 100% reused but regulations do not allow us''*. R&D3 thinks also if manufacturer shows 100% reusable concrete, Bodø municipality will not take the risk to establish them, as regulation does not allow them. But R&D4 informs "*both doing reuse and recycling it is possible to make 100%, not only by reusing concrete''*. C&M1 thinks that regulations and laws are very conservative, and storage facility for sorting wastes is a necessity and waste handling is a time consuming and demotivating procedure. R&D4 also says, *''standard and regulation are causing some misunderstanding or it's just everybody so used to thinking about the regulation as this is the only solution''.* Most of the participants do not have a clear idea on how and why regulation is a barrier for reuse. Some of the participants did not mention about regulatory barriers while giving answers regarding potential barrier to reuse rather they mentioned others significant barrier for instance, lack of market, storage, and logistic facility.

Lack of market for reusable materials was significantly mentioned by all of the participants. All of them demands for having an establish reuse market in city. Collecting materials with desired

quality and quantity takes time, lack of logistic and storage facility is a barrier that are significantly mentioned mostly by architects (A&C1, A&C2, A&C3, A&C4). A&C3 shared a story about the high storage and maintenance cost in Solvær, Lofoten, Bodø, and such costs compelled the entrepreneur to get rid of old materials. FPO1 says that logistics is the worst barrier in Bodø and mentions other barriers such as lack of networking opportunity, knowledge, and skill gap.

While mentioning about potential barriers, Pub3 informs that most of the old buildings were not made in a way to reuse, and present-day consumers have new taste and special demands. So, it does not match with those of the existing old materials. Pub3 shares "*door from old building is small, but demand says they need big, the height of the old building from floor to roof is not enough and not the same how consumer demand''.* Pub1 thinks most of the construction business organizations like to operate in the same way that they run their business now. Pub1 shares, "*this is the main barrier, they think changes are scary, has financial risk, instinctive fear for change, and don't want to shift from their comfort zone''*.

Participants from R&D (research and development group) and from C&M (construction and manufacturer companies) mention lack of financial capability, legislations, and uncertainty for profitable business and these are some of the potential barriers of reuse of construction waste. R&D2 mentions*, "one company is there because they need money, they need profit''.* C&M2 also shares *"at the end business need to be profitable and it should be ensured''.* C&M1 thinks, *"money is the big matter as it is sometimes expensive to utilize old materials*''. Participants from public sectors also agreed that a sound financial status can give them the ability to take risk.

A&C4 informs that many actors are involved in the reuse of construction waste and hence, it is a bit complicated compared to "*food production of ecological way*". WMC2 also agreed that there are heterogenous actors such as project leaders, but there exists a gap in collaboration and practice among them. WMC2 points out, *"one of the problems is you have project leader here, you have a project leader there, you have a project leader here and they don't talk together also*''.

Most of the participants think that differences in the mindset of people and profit driven business practices are the main barriers for practicing reuse in construction sector. Some of them think that there are not many good examples and stories for getting motivated. C&M1 and C&M2 strongly agreed "*we need more successful stories and examples''*.

R&D2 critically mentions about the barrier of knowledge gap of different actors of construction sectors. R&D2 explains the most essential criteria in reuse is "*we need to know what the possibilities and limitations are''*. R&D2 thinks that to integrate reuse elements it is important to know the regulations for new buildings that they should comply with. After having proper understanding about the regulations for new buildings we can think of implementation of the policy for reusing. Without knowing the policy for the end utilization of the old elements, it is not possible to implement. R&D2 shares "*you don't know what you are aiming to do, you are trying to increase the reuse, but you need to know first, who's going to use it, under which conditions we're talking about this''.*

4.7 Practical solutions and way forward

I wanted to know about the way forward and practical solutions to encourage the reuse of construction materials in this city. Two participants, Pub1 and Pub3, from public sector agreed that citizens of Bodø and other stakeholders should realize the need for changing their traditional pattern of thinking, they should feel obligation to reduce the environmental impact, contribute to climate goals and sustainability of the city. Pub3 also thinks, *"it is about information, about awareness, and it is important to make them convinced that it is smarter way to reuse''*. Another participant from public sector, Pub4 thinks that they do not have appropriate solutions and there is a lot of system lacking in Bodø. Pub4 says, *"it's a challenge for municipality, but municipality is trying to find good solution, it's true that, there is system lacking, and we are trying to find solutions*".

Participants thinks that any activity probably can be done in a sustainable way, but it may not always be financially beneficial. Pub1 mentions the necessity of research and development in the business cases of private companies. To get financial incentives from Bodø municipality companies should carry out research on business cases based on circular economy. Pub1 explained that in the case of companies that are interested in circular public procurement, suppliers can be chosen if they have performed research in their business cases and are willing to do business in a more sustainable and smarter way. By this way the companies can practice reuse of construction wastes and can contribute to make smart sustainable city. Pub1 also mentions, *"we don't want to think the old materials as waste, we want to reuse it, we want to store it, so we want storage facility''*. Pub2 thinks that as regulation and legislation have brought some changes, it will bring some solutions to enhance reuse mapping and sale of the product.

All the participants emphasized on developing a reusable building materials market in Bodø and indicated the necessity to have an established market. They also mentioned the importance of having storage facility, logistics, knowledge, and expertise. Pub3 thinks green certification for the building, setting demand for improving sustainability profile, information sharing and storage facility with easy access to materials can be the practical solutions to stimulate the use of reusable materials. Pub3 also mentions *"we need to set demand that they need to reuse''*. Participants emphasized on having a good system where customers can get interested to buy reusable materials, stakeholders will get to know of the certainty of consumer demands, and Bodø municipality will lead with a clear vision. WMC2 wants Bodø municipality to act like *"This is our need, we want this, we take ownership to reuse, and can you help us with that?''*.

Participants (C&M1, C&M2, WMC1, WMC2, and A&C3) emphasize on the importance of having good examples or practices that can motivate others. If stakeholders and consumers understand that reuse of construction materials are getting admiration and brings good results, it will inspire organizations.

While talking about solution to enhance reuse WMC1 says, "*my main message is to dismantle building materials in a way that we can reuse its parts, not to crash it and go for recycling and landfill''*.

Respondents think 'Bodø storstue' and 'new city new airport' projects will create positive attitude for acceptance of reclaimed materials but the original practice of reuse of building materials should be enriched by advancing our knowledge and experience.

A&C3 suggests that it is important for Bodø municipality, which has got information about all the buildings in the region, to confirm the reuse potential of old buildings that are to be demolished. A&C1, A&C4 indicates that an architect should accept a reusable material based on their potentiality and creativity build up because doing something new with old materials can bring good for all.

According to A&C1 and R&D3 Norway is a rule-oriented country, and Norwegians are obliged to follow rules. So, if the government and administration take some systemic rules signifying the reuse of construction waste to attain climate goals and sustainability, it will work, and citizen and stakeholders will come forward to follow the rules.

Most of the participants are optimistic about the future of reuse of construction materials in Bodø although it will take bit time to get established. They think building materials reuse will

thrive, if Bodø goes in a proper direction, as new generation are morally stronger about environment than previous generations in Bodø, but some of the participants are uncertain about its future.

5. Analytical Chapter

The main aim of this master thesis is to give insight into the current practice of reuse of construction waste in Bodø City. In this chapter I will analyze the empirical findings based on that empirical data that I collected by conducting a semi-structured interview and based on the information in the theoretical chapter. First, I will discuss the key issues of the study which are— significance of reuse for the potential smart and sustainable city, market status, availability of the reusable materials, stakeholders' motivation, consumer preferences, national and local level policy, success factors, potential barriers for reuse, and practical solutions for Bodø. I will also describe the current practices by looking through the lens of organization's decoupling theory. Finally, I will summarize the analyses.

5.1 Significance of construction material reuse for the potential smart sustainable city Bodø

Bodø has smart sustainable city plans such as efficient waste management in Bodø area, especially at the new airport (Bodø municipality, 2017 (a), 2017 (b)). In addition, the city has ambitious environmental and climate goals. Empirical findings reveal that construction materials reuse is important for attaining Bodø's environmental sustainability and climate goals since reuse is less energy and resource intensive than recycling and is associated with less emission. Participants also think, reuse of construction waste can create new businesses, thereby new local jobs for the society which can reduce the regional unemployment and occupational mismatch. Job opportunity and new business growth by CE bring better living condition for the people, enhance cooperation, collaboration, and overall wellbeing of the society (Nikonorova et al., 2020). Public sector participant (Pub4) anticipates socio-cultural benefits from the reuse of construction waste, for example, keeping the old runway as it is now Bodø will be able to preserve the culture and history of the city. CE practice generates remarkable outcome in socio-cultural, economic and environmental aspects for a city (Ellen MacArthur Foundation, 2017). Based on one of the interviews, smart and sustainable does not, exclusively, mean environmental sustainability, it also means to make a system that can sustain and bring greater wellbeing in terms of environment, society, culture, governance, and economy for the city. Smart and sustainable city contains five main aspects. They are environment, socio-culture, economy, and governance (Azadeh Dindarian, 2021; ITU, 2015). So, an initiative should cover all the five aspects of smart sustainable city to be justified as a smart and sustainable city initiative (Azadeh Dindarian, 2021).

Participants emphasized on maintaining waste hierarchy for construction waste management. They also think reuse of construction materials should be implemented with an intention to create value for the society and environment. From an organizational perspective, when an organization decreases construction waste it promotes green image and improves competitiveness of the company (Rakhshan et al., 2020; Tura et al., 2019). Participants also think reusing construction materials will save high logistic cost as Bodø imports almost all the materials. From an economical perspective, CE provides the opportunities for new value creation, cost saving and profitable businesses (Tura et al., 2019).

Uncertainty and ambiguity also exist among some of the participants about the definition of reuse of construction waste, and emission reduction potentiality of construction reuse. Some of the participants were not certain about the reduction of emission caused by reuse of construction waste. They, at least, are certain about the fact that reuse reduces pressure on virgin materials. Because of the limitation of knowledge among different actors reuse of construction materials is still facing skepticism and is often being questioned in Norwegian building industry (Knoth et al., 2022).

Respondents think that construction sector has a great role to contribute to the city's sustainability and climate goals as the sector has a leading position in creating environmental footprint. The construction actors should be made aware of the profitability of construction reuse. Still in Norway circular reuse of construction materials is plagued by financial risks, uncertainties in quality materials, lack of available materials and so on (Knoth et al., 2022). These uncertainties are the reasons behind the unwillingness of the actors to take risk (Knoth et al., 2022).

Some of the interview answers indicated that construction organizations are scared about their existence and that is the reason behind their implementation of reuse in their system. Some companies employ circular business to comply with institutional pressure, to gain social legitimacy and also to ensure their existence (Jain et al., 2020).

5.2 Availability of the reuse materials, market, consumer preference & stakeholders' motivation

An established market, supply chain management, and good collaboration among stakeholders are necessary for enhancing circular solutions (Tura et al., 2019). Online and physical platform with standardized product information about material durability, material composition, health

and safety can abolish misconception and uncertainty about market and can make reuse more predictable (Knoth et al., 2022; Nordby, 2019). Empirical findings reveal that at present Bodø does not have a market for reuse of building materials. An established platform is very necessary to promote this practice in the city and to abolish misconceptions about the difficulties of reuse of construction materials. One of the participants (A&C1) shared their contributions for establishing online platform for selling reusable materials, but it has not yet evolved like other online business platforms because of the inefficiency of the website. Lack of compatible technology is a barrier for the establishment of CE practice (Tura et al., 2019). Pub3 informed that they had plans to establish a physical platform in Bodø, but it did not work out in a positive way because of consumers' unwillingness. According to Kirchherr et al. (2018), low enthusiasm and lack of awareness of the customers are critical barriers of CE practice.

Empirical finding shows that a cheaper price can be the best motivating factor for consumers. In addition to that attractive design and materials' database with information and functionality of the product can effectively motivate consumers. Interviews indicated that reusable materials should have appealing design and quality that customers prefer. Visual appearance of the reusable materials will be a consumer's significant deciding factor. Hence, the decision is highly subjective, and the materials should be appealing to the customers in order to create demands (Rakhshan et al., 2020). Virgin materials' price is sometimes cheaper than reusable materials and quality is more consistent and convenient to utilize them in construction work (Knoth et al., 2022). Lower price of the reusable construction component will increase demand and contribute to the overall cost-saving of a construction project (Rakhshan et al., 2020). In the long run this increases demand of reusable materials that will help to generate revenue as well as growth of the reuse market (Rakhshan et al., 2020).

While talking about maintenance of the quality of construction structures made from reusable materials compared to the virgin material-based structures, it is clear that the respondents do not have an idea about this subject. It was challenging for the participants to figure out, how to maintain the quality of reusable materials compared with new materials. If there is a lack of confidence about used components' quality, it negatively affects reuse market, because if, in case, they are of low quality they might deteriorate the construction quality (Rakhshan et al., 2020).

Respondents from architect and consultancy group (A&C1, A&C4) think that reuse practice should be a way of utilizing architects' potentiality and creativity. Customers can be better

informed by an architect about knowledge of reuse strategy, reuse materials design, and improved design strategy (Park & Tucker, 2017). Thus, architects can abolish misconceptions and facilitate reuse (Park & Tucker, 2017).

Empirical finding shows that as Bodø municipality is involved in different research projects regarding CE in construction waste, and significant projects such as 'new city new airport', and 'Bodø Storstue' will bring in valuable insights about the reuse of construction materials for entrepreneurs. Strategy and starting culture about CE in organizational core bodies act as drivers for circular economy implementation (Tura et al., 2019). Incorporating new projects about reuse generates holistic ideas and knowledge for others through trial and error that can also promote reuse practices (Knoth et al., 2022). Reuse is hindered by lack of knowledge about potentiality of the materials that can be applied in direct reuse (Rakhshan et al., 2020). Empirical findings pointed out the uncertainties regarding the information about the easiness in use of the materials. But discrepancies about the easiness prevail among respondents and their choices were different, their selection included concrete, wood, brick, brick made wall, and steel.

Interviewees agreed that it is important to make the stakeholders understand the financial benefits of circular reuse in construction to motivate the stakeholders in Bodø. High economic uncertainty will not nurture CE as it is challenging to define and measure the long-term benefits of CE (Tura et al., 2019). Circular public procurement[4] and rewarding to risk taker company can be the best motivations to stakeholders (Knoth et al., 2022). New tax structure, tax exemption, and public funding for innovation and research development opportunities can help organizations to reform their CE-based operations (Nordby, 2019).

5.3 National and local policy and support

Empirical findings show that some of the participants have little information of national and local policy. Some participants mentioned about the Norwegian regulations regarding the reuse of building materials while talking about national and local policy. Participants mentioned TEK17 that makes reuse practice complicated. One participant (A&C3) indicated that TEK17 puts the responsibility on the buyer's side. Hence, they find it challenging to follow the regulations and hardly anyone wants to take the responsibility to reuse. Among the participants,

[4] Circular public procurement: The process through which public agencies purchase services, works, and products that aim to support closed materials and energy loop while minimizing/ avoiding environmental consequences and waste generation throughout their entire life cycle (European Commission, 2017)

there is opacity about the regulations on reuse of construction wastes. Pub4 thinks that TEK17 does not decide on the requirements for reuse mapping. But in §9-7 of TEK 17, there are guidelines and instructions for reuse mapping (Direktoratet for Byggkvalitet, 2022), and Pub2 was aware of these changes in Norwegian regulation that was put forth in last summer, 2022. Pub2 thinks that the changes will be the positive drivers to stimulate reuse, whereas Pub3 is of opinion that regulation and laws of reusable materials need to be more ambitious to fulfill climate goals. Most of the participants do not hold any transparent idea about national policies, regulations, legislations, and current changes in Norway regarding selling and utilization of reuse materials that are mentioned in the news of (Ministry of Local Government and Districts, 2022).

Empirical findings also indicate that there exists confusion and discrepancy about sufficient collaboration between Bodø municipality and stakeholders, the municipality's vision, and original practice. It is also revealed that Bodø municipality holds passion for circular economy and reuse of construction materials, but they need adequate financial access. High up-front investment cost and poor access to financial capital and low funding on CE interrupt effective actions on CE initiatives (Grafström & Aasma, 2021). While deconstruction is a labor intensive activity, waste sorting is a time-consuming and costly process that has to be done with care (Rakhshan et al., 2020). Designing reusable components is a meticulous job and requires funding (Dunant et al., 2017), and maintaining such components needs logistic and storage cost (Rameezdeen et al., 2016). The empirical findings also revealed that sometimes people want to get rid of the old materials to save storage cost.

5.4 Success factors, potentiality, and opportunities

Participants think that Bodø municipality's involvement in circular economy and their CE-aimed ambitions are success factors of the city. Circular integration in organization's goal and strategy and developing skill and know-how enhance CE practice (Tura et al., 2019).

Participants also indicated that although Bodø municipality has competency there is a lack of knowledge regarding practice of reuse of building materials. Nevertheless, they are of opinion that Bodø municipality will learn from their continuous involvement. New city new airport and Bodø Storestue will be an opportunity for Bodø to establish the practice of building materials reuse and to get practical expertise for the actors. New pilot projects provide opportunities to

the actors of construction sectors to gather knowledge and to be more skilled on process and practice surrounding reuse (Knoth et al., 2022).

Empirical findings also reveal that as Bodø is not a big city it is easily possible to build up collaboration among stakeholders to make them agree on reuse practice. Materials are mostly imported and takes long delivery time. Good collaboration among the stakeholders in the supply chain management in Bodø will be beneficial for the reuse practice in a greater way. Supply chain management, good collaboration among stakeholders and management of reverse network can help to get effective circular solutions (Tura et al., 2019).

5.5 Barriers and solutions

Bodø has a lot of limitations in reuse of construction waste, and this city is not still prepared for implementing reuse practice in construction sector. Findings show that in Bodø the old buildings were not made with a vision to reuse. Buildings were made using old technology and according to the old standards that do not comply with the existing standards of energy efficiency. One of the participants also mentioned that if the reuse of components does not make the final building energy efficient, the strategy cannot be counted as success of reuse. One study carried out by Ng and Chau (2015) concluded that when old doors and windows are reused, their energy saving potential are 50% and 48%, respectively.

All the participant mentioned about the barrier which is absence of matured and established reusable building material market in Bodø. In supply chain management lack of an established market is worst barriers to enrich the reuse practice of building material (Rakhshan et al., 2020).

Interview answers indicated that old buildings were not designed for easy dismantling and future reuse. This points out the complexity to meet the current consumer demands and preference. The existing constructions were not built with a view to reuse further, it is one of the most practical barriers that interrupt reuse (Knoth et al., 2022). To improve the circularity of the construction materials by preserving their highest possible value it is important to consider flexible deconstruction procedure incorporating innovative technical solutions (Knoth et al., 2022).

Almost all the participants strongly demand a reliable, established market for reuse of building materials. In Bodø, material availability is limited and there is no platform with information about reclamation of old materials. Architect and consultancy group clearly indicated the need

for proper materials prior to the start of construction works. It is necessary to purchase reuse component in the beginning of the project to cope with the uncertainty of its availability (Rakhshan et al., 2020). Time management, logistic and storage facility are some of the most interrupting barriers in reuse (Knoth et al., 2022).

Interview answers also revealed that reuse of construction waste in Bodø city cannot be fostered properly because of the silo mindset of the stakeholders and lack of enthusiasm of the customers. Reuse practice is greatly influenced by socio-cultural factors such as people's perception, mindset, custom, behavior (Knoth et al., 2022).

Regulatory support is more significant for wider implementation of construction reuse (Rakhshan et al., 2020). Some of the participants mentioned that 'TEK17' is creating barrier for implementing reuse. Empirical finding also indicates the lack of understanding of the aim of reuse of construction waste and knowledge about existing regulations. Regulation is not the only main barrier there are other barriers also that constraints the use of old construction materials in Bodø city.

Interview answers imply that managerial ambiguity, complicated culture with heterogenous practice and actors and lack of collaboration among authoritative bodies (A&C4, WMC2) make things complicated. Organizations face challenges when there is weak management support and heavy organizational hierarchy that inhibit flexibility and innovation of CE practice (Tura et al., 2019). Lack of collaboration among actors interrupts the development of a common understanding about CE-based decision and this deficiency makes CE practice more complex (Tura et al., 2019).

Respondents noticed profit driven mindset among stakeholders and strong focus on existing mainstream practice that are hinderances to reuse. Respondent from public sector (Pub1) pointed out that business companies should have research and development activities to get information regarding financial risk or barriers associated with their services. In addition, companies can get financial incentive as a form of circular public procurement. Drivers and barriers of CE practise is context specific and hence, a business concept that succeeds in a particular context can probably fail in another one (Tura et al., 2019). So it is not a wise decision for a firm to copy business concepts directly from other firms, rather they should find out their crucial drivers and barriers by analysing their own internal and external environments (Tura et al., 2019).

Empirical findings also point out lack of good stories, examples and established practices that could motivate stakeholders to reuse. The widespread existence and visibility of CE practice among the competitor organizations enhance the feelings of relatedness of entrepreneurs (Rovanto & Finne, 2022). While CE practice is visible among the peers it makes entrepreneurs feel secured of relatedness of shared values (Rovanto & Finne, 2022). Showcasing the best-practice case study and advancing practice-based learning can help ward off the misconception regarding reuse of building materials (Knoth et al., 2022)

Although the best solution for driving the reuse practice in construction sector in Bodø is not yet decoded, participants recommend some of the probable solutions. Most of the participants think that Bodø needs established reuse building materials market with logistic facility, information, documentation of reclaimed materials to abolish the skepticism and misconception regarding old materials. A market with available information about old building products and efficient logistic facilities that will create a proper system can promote the practice of reuse of building materials (Knoth et al., 2022; Nordby, 2019; Rakhshan et al., 2020).

Empirical finding shows that it is crucial to have a positive mindset and enhanced social structure to accept reclaimed materials in this city. However, this is possible only by sharing information and through collaborative activities. When different group of actors involved in construction materials reuse start a joint endeavor that will bring in continuous improvements in construction reuse (Knoth et al., 2022).

Interview answers pointed out that sufficient funding possibilities can significantly drive the organizations to shift to CE practice. ENOVA (Norwegian state-owned enterprise for energy efficiency improvement and development of low emission society) can act as a funding agency for organizations to motivate on CE reuse in building materials (Nordby, 2019).

Empirical findings imply that new projects such as ‘Bodø Storstue (Johnsen, 2022), and new city new airport (Bodø municipality, 2017 (a)) will be the potential drivers that introduce culture, knowledge, experience, and example for CE reuse to the city. But first, it is necessary to have proper knowledge about the aim of reuse in construction materials, its possibilities and limitations for Bodø. REBUS (reuse of building materials - a user perspective) as well as other Nordic and European activities linked to construction material reuse can trigger the generation of knowledge and experience (Knoth et al., 2022).

Respondents mentioned about the necessity of reuse mapping by Bodø municipality to disclose the source of the old components for further use. Reuse mapping is part of reuse infrastructure

and is essential for perceiving knowledge about the potential reusable materials (Knoth et al., 2022). Currently TEK17 also emphasizes reuse mapping and disclose new regulations to facilitate reuse mapping (Ministry of Local Government and Districts, 2022).

Green building certification and demand for reuse percentage in construction work can drive the market suggested by public sector respondent, Pub3. Green building rating by Building Research Establishment Environmental Assessment Method (BREEAM) and Leadership in Energy and Environmental Development (LEED) and environmental policies can stimulate the start of reuse of construction waste (Rakhshan et al., 2020).

Norway is a nation with obligation to follow rules. Effective rules and regulations can bring solutions to reuse of construction waste in Bodø suggested by participants. Effective initiatives from government can set rules for waste and resource management, thereby enhancing reuse (Knoth et al., 2022). For instance, if government enforces a cost for waste treatment by considering the superiority of waste management options in waste hierarchy that will favor reuse (Rakhshan et al., 2020).

5.6 Looking at the empirical findings through the lens of organization's decoupling

As Bodø aims to be a smart sustainable city, it should have effective planning towards CE reuse in waste management. A city should be sustainable in terms of waste management when it wants to be a smart sustainable city (Schipper & Silvius, 2018) and waste generation is an important indicator of smart and sustainable city (Pira, 2021). Reuse of construction waste can be an effective option for waste management. From the literature review we know that reuse is placed as the second-best option in waste hierarchy. Reuse of construction waste can bring not only environmental sustainability for the city, Bodø but also the social wellbeing and economic productivity. Empirical findings show that Bodø city is encountering different barriers when it strives for reuse of construction waste. I have identified several barriers like knowledge and experience gap, mindset of citizens, lack of market including logistic and storage, technological efficiency, legal framework, financial capacity also lack of collaboration among actors, and opacity about actual reuse practice in construction sector, institutional pressure, lack of ideas about opportunity of reuse and limitation to reach the final goal. We can see the current practice of reuse of construction component in Bodø from the lens of organizations' decoupling.

When organizations have limited resources, infrastructure, capacity and knowledge they fail to comply with the policy, thereby decouple the policy from internal practice (Bromley & Powell, 2012). Even though organizations devote their resources to implement policy, they cannot attain their intended goals. Means (practice for intended goals) is decoupled from end (outcome) (Bromley & Powell, 2012). Organizations decouple when they don't know about the causal link between the action and outcome of a policy, and face practice multiplicity from heterogenous actors with behavioral invisibility (Wijen, 2014). Interviews revealed that in Bodø, construction reuse phenomenon concerns multiple actors and concurrence of heterogeneous routines (different projects leaders having lack of collaboration in their works, WMC1 and A&C4) that make the original practice complicated. Decoupling literature mentions this situation as practice multiplicity (Santos & Eisenhardt, 2009).

Empirical findings also point out that there is a lack of understanding among actors, about the key benefits that reuse of construction waste can bring for this city. Decoupling says this is the situation of causal complexity and cause and effect opacity which motivates organizations to adopt superficial practice (Levy & Lichtenstein, 2012).

Interview answers indicated that actors cannot be motivated because there is lack of good examples and stories in Bodø which are demotivating, and they cannot acknowledge the overall benefits of circular reuse in construction sector. This situation is considered as behavioral invisibility which demotivates organizations to comply with the policy (Aravind & Christmann, 2011).

Practice multiplicity, behavioral invisibility, and lack of understanding about cause and effect are factors for compliance barrier that make a field more opaque (Wijen, 2014). Opaque field is surrounded with lack of inspiration, attention and knowledge that creates uncertainty and ambiguity for policy practice (Wijen, 2014).

There are reports (Knoth et al., 2022; Nordby, 2019) on regulation and legislation regarding sale and utilization of reusable building materials and the associated barriers are considered hinderances to the practice of reuse of building materials in Norway. But in the case of Bodø, opacity and lack of knowledge about regulation and legislation and overall practice, are also worst barriers, I believe. Based on my empirical findings, it is not clear whether regulations and laws are main barriers in Bodø or more focus and concentration on regulatory barriers are resulting in lack of importance to other crucial barriers.

From the in-depth interviews it is clear that in Bodø reuse of construction materials is interrupted by ambiguity, lack of financial capacity, lack of reusable infrastructure, knowledge gap, and institutional pressure. These factors might be the reasons that compel the organizations to decouple policies and practices in Bodø and hinder the achievement of the final goal. The current practice of reuse of building materials in Bodø by following figure.

Now I will discuss the extent of the abovementioned factors that are hindering the reuse of construction materials in Bodø. Although different participants give specific importance to the different barriers based on their perception, most of the participants significantly mentioned about the necessity of having an established market. Lack of market is the main barrier that is placed in the first position in case of Bodø according to the empirical findings. Furthermore, lack of proper information about reclaimed materials and logistic are also significant contributor to hinder reuse practice. Knowledge, experience gap, and ambiguity are the other important factors that are found to interrupt an efficient reuse practice in Bodø. Reuse of construction waste is still an obscure and vague concept to most of the participants in the interviews. The practice is not yet regarded as motivating to the actors because of ambiguity and opacity including multiple heterogenous routines, differences in opinion or activities of other actors, lack of understanding about long term benefits of reuse. Most of the participants are concerned of the unavailability of reusable materials in Bodø, whereas others are unaware of the materials that are easier to reuse. Participants are in opaque state on the old materials' quality should. Regarding the regulations for reuse, participants know about TEK17. Some participants do not have knowledge about regulation and national policy of reuse while some of them seems to have a vague concept. The interviews also revealed the importance to know properly about the possibility that reuse can bring to the city and what are the limitations for Bodø to gain such benefits. Inadequate financial access by Bodø municipality and organizations also severely exists in Bodø city, as revealed by the participants. Lack of collaboration between Bodø municipality and stakeholders is also mentioned by some of the participants but not by all. These factors decouple the practice of reuse of construction material from actual organizational practice and create barriers that hinder the achievement of the goal of practicing the reuse.

5.7 Summary of the analyses of the empirical findings

Here, I summarize the findings concerning the reuse of building material in Bodø. The reuse stimulates new value creation for business organization, environment, economy, and culture and society. Reuse of building materials is surrounded with critical barriers even though significance of such practice and waste hierarchy concern exists among the organization's actors. Practice of reuse of building materials are interrupted due to lack of market, logistics, storage facility, and adequate funding access for organizations. In addition to these, knowledge gap for cause-and-effect relationship of reuse of building materials, experience gap linked to reuse practice, practice multiplicity, lack of collaboration among stakeholders, lack of good stories and examples are making this policy of reuse of building components opaque. Hence the organizations are facing uncertainty and ambiguity. Institutional pressure compels actors to accept policy of reuse of building materials in order to secure their existence although they do not have sufficient knowledge about it. These barriers are interrupting the practice of reuse of building materials in Bodø, thereby decoupling policy from practice and preventing the organization to reach their final goals. Although regulatory barriers of sale and utilization of reusable building materials are reported as one of the main barriers in Norway (Knoth et al., 2022; Nordby, 2019), my findings point to the lack of market as the critical barrier and the limited understanding regarding the current regulation and legislation among different actors.

6. Conclusion

This thesis focused on the current practice of construction material reuse to delineate the associated market status and barriers in Bodø city, with an aim to give answer about the contribution of reuse of building materials towards smart sustainable city. I used the results from previous research on smart sustainable city, circular economy, circular reuse for construction waste management to understand the link between circular economy reuse in construction waste management and city's smart sustainable vision. I have analyzed the importance of reuse of construction materials for creating smart sustainable Bodø in future and bring out its potential benefits through empirical findings and literature review. I presented the current situation of construction material reuse practice in Bodø through the lens of organization's decoupling theory. From data analysis and literature review I believe that for the city's sustainability, circular economy-linked reuse of building materials has the potentiality to make city more sustainable based on social, economic, and environmental aspects.

The city's smart sustainable initiatives can consider proper governance-based sustainable waste management as an important factor during the journey to reach the ambitious goal of smart sustainable Bodø, by creating a system that considers waste hierarchy and environmental sustainability. Waste management should be guided by waste hierarchy that has emerged based on circular economy. Although Bodø city has an ambition to apply circular economy principle in construction waste management, reuse has not been proactively established in the city. The culture and history of Bodø can be preserved by retaining the runway or any other structures of the city, thereby attaining socio-cultural sustainability. Empirical findings indicated a raft of interrupting factors, which can be insights for Bodø to understand the limitations and way to achieve success through a credible position of circular economy in construction waste management. Unfavorable situations such as complexity in reuse practice and heterogenous actors as well as inability of an organization to accept and comply with the policy of an institution have also negatively affected their intended goals even if it implements policy. Furthermore, through the lens of organization's decoupling theory I could connect the factors behind decoupling with the interrupting factors of reuse practice of building materials in Bodø city. This helped me to understand better the gap between policy and practice of building material reuse in Bodø and how the current implementation of policy might not be successful to attain the goal. Furthermore, understanding of barriers with the decoupling lens allowed me to provide with some recommendation of implications around reuse practice. Bodø is ambitious to apply circular economy in waste hierarchy-based waste management, but they have lot of

limitations that is making the practice blurred. Reuse of construction materials is an opaque practice with lack of knowledge, experience, motivation, market, materials, logistic, financial capability. Nevertheless, it is not clear from the interviews if regulations can be considered as the main barrier because of a vague and incomprehensive understanding among most of the respondents. A city with a smart sustainable mission and circular solution as a tool has stakeholders with limited knowledge about regulations regarding reuse of building materials; this is an unexpected finding. The associated projects concerning reusable building materials have not obtained a wider reach among the stakeholders. I also found that Bodø municipality has lack of collaboration with the stakeholders and hence lack of information sharing has led to uncertainty of profitability in business. This thesis also finds that there exists a lack in established reuse material market, logistic and storage facilities. I found that some of the participants is of opinion that Bodø municipality is not dedicated to finding the potentiality of the business organizations in their territory. Another limitation is lack of adequate financial incentives among the service provider organizations that prevent the reuse practice of building materials.

6.1 Contribution of reuse of building materials towards smart and sustainable city, Bodø

Here, I attempt to answer the main research question of this thesis; ***How does reuse of building materials contribute towards smart sustainable city, Bodø?***

Empirical findings indicate that reuse of construction waste has potentiality to generate city's sustainability, from environmental, social, economic, and cultural perspectives. Bodø is going to be a low emission city in the near future and the city planning aligns with climate goals and reduction of CO_2 emission. The local government's consideration of the climate and environmental concerns for example the reuse of construction materials aligns with smart sustainable city vision. In city planning, Bodø focuses on their culture also, as revealed from the empirical findings. Reuse of building material can benefit Bodø culturally, also observed in the empirical findings. In this Arctic city, reuse of building materials has the potential to promote entrepreneurship, create jobs and retain talents. Interview reveals that reuse of construction waste can save the higher logistic cost as Bodø imports construction materials from outside. Thus, reuse of construction material will reduce the pressure on virgin materials. This thesis reveals that the reuse of building materials i.e. managing city's urban resources (infrastructure, financial and human resource management) provide sound governance

condition for the smart sustainable city. Effective management of urban resources from an economic perspective can be attained by applying sustainable management of resources, which could be made available by exploiting the reusable building materials. Reuse of building materials provide the opportunity to Bodø by connecting multiple stakeholders including citizens, external and internal stakeholders, as deciphered from the empirical findings. When stakeholders including citizens are involved in establishing the practice of reuse of building materials, collaborative and sharing network will be in place to support city's smart and sustainability vision. The empirical findings indicate the need to spread awareness, share information and involve citizens and construction actors to promote the reuse of building materials.

The practice of reuse of building materials gives Bodø the opportunity to connect citizens and construction sectors to facilitate information and opinion sharing and enhance awareness to guide to the way forward regarding the establishment of reuse of construction materials in this city. Bodø municipality has the authority to decide the construction waste treatment costs to favourably affect the reuse of building materials. I found that the architects have the potential to facilitate the practice of reuse of building materials as they can influence the citizens. It will result in more sustainable construction resource consumption and waste management, in the potential smart sustainable city Bodø. Reuse of building materials can generate environmental, economic, social and cultural sustainability in this city. Also, it can create collaborative and participatory governance which are crucial for smart and sustainable city vision.

Technological and digital solutions can promote city's sustainability. During the implementation phase, the smart sustainable city requires technological solutions including infrastructure development and robust technology. I found that efficient online platform technology and a physical marketplace with proper information of old materials are key elements for establishing the practice of reuse of construction waste in Bodø. A new infrastructure for physical marketplace can be considered as infrastructure building as Bodø is at the very beginning phase of its smart sustainable city mission. In this way, reuse of construction material can stimulate the application of smart solutions in Bodø.

6.2 Practical implications

I could derive certain implications from this study to provide suggestions to the public sector, waste management companies, architect firms, research and development sector and

construction and manufacturing sector to contribute to the proper reuse of building materials in Bodø. A sound collaboration among these stakeholders is key to develop such practice more efficiently.

The local authorities have to be skeptic about reusable building materials; they should know what they have and what they do not have right now. They should consider reuse of building materials as well as sustainable waste management as another department of their municipality like the other departments such as better education, safety, health, and ICT. They should utilize workforce more efficiently to make the reuse practice attainable because we have to think about sustainability and circular economy for the existence of the planet, our generation and future generations. Furthermore, Bodø municipality should also allocate sufficient funds and projects to the stakeholders. They should have a continuous and efficient way (practice-based learning) of spreading knowledge required to enhance the reuse of building materials in the city.

Waste management companies should have efficient waste sorting infrastructure to favor the reuse of building materials and a core concept of waste hierarchy. They should help the municipality to prepare reusable material mapping. They should be concerned of the value of the reusable building materials. They can inform the other stakeholders the practicality of reusing the selected building materials and suggest any required changes during the construction of new buildings.

Architects have great potential to enhance the reuse of building materials in Bodø. Their professional responsibility should stimulate them to come up with innovative ideas and designs and knowledge for the construction companies so that the reused materials can persist in our society for a long time. Bodø municipality should exploit their potential and support them to establish the practice of building material reuse.

The greatest responsibility lies in the research and development sector because Bodø is in the start phase of the smart sustainable vision. This sector can provide detailed information required for effective reuse of building materials and gradually close the knowledge gap regarding all the practical aspects such as reuse caused energy efficiency, potentiality of specific reusable building materials, ranking them for selection by the construction companies, reuse-assured design of virgin materials for long-term use, possibilities and limitations of reusable materials.

Construction and manufacturing sector should have an open mentality to cooperate with other institutions like architect firms, waste management companies. They should act proactively to

increase the reuse of building materials. They should make others including Bodø municipality aware of their services, contribution, and interest in reuse. Their research and development unit should undertake projects to analyse their business cases connected to reusable building materials.

Social organizations that are interested in the practice of building material reuse should come up with innovative solutions to shift the mindset of the stakeholders. They can also motivate reuse-based entrepreneurship in Bodø.

An effective supply chain management and reverse logistics will help establish a reuse-based market. This will reduce the import of virgin materials and solve the issue linked to the scarcity of resources.

Thus, all stakeholders should always have a mindset to contribute to the new projects (‘Bodø Storstue’, ‘New city new airport’) connected to the smart sustainable Bodø. In addition, the governmental bodies should set strong rules like those connected to the implementation of electric car use in Norway. In general, Norwegians are known to comply with rules, and this is how sustainable waste management can be established in Bodø city.

6.3 Limitations of the thesis

There is a lack of relevant studies in Norway and specifically in Bodø regarding circular economy-linked reuse of construction materials. So, I could not procure more information and studies about construction material reuse in Norway, not to mention those in Bodø. I think this is a limitation of my study. Reuse of construction waste in still an emerging concept in Bodø and hence, getting the appropriate information from participants was challenging. Though it is a new phenomenon, participants have the knowledge about waste hierarchy, construction waste management and circular economy practice in construction sector. I considered the answers from some participants that know about circularity in construction but do not have knowledge about reuse practice of construction materials, thinking that this will also be a valuable finding for my study. I got only two participants from manufacturing and construction field, and I did not interview the citizens of Bodø. I consider these also as limitations of my thesis. I could have included more information if I had obtained an opportunity to interact with some of the citizens to know their mindset, demand, and perception about circular reuse in construction materials.

Despite the limitations, I believe that I have illuminated an important issue by studying some aspects of reuse of building component for potential smart sustainable Bodø. I think that I have generated critical baseline information to initiate the reuse of construction waste and added a new aspect to circular economy as a whole the development of Bodø municipality.

6.4 Suggestions for further research

Future studies about construction materials reuse should consider the following recommendations:

Based on my study, I understand that reuse of construction waste is a new phenomenon in Bodø. It is important to have the proper idea about consumers' (citizens) thoughts, expectation, and consideration about the phenomenon of reuse of building materials by conducting a qualitative research. On the other hand, through a quantitative study on citizens behavior a researcher could disclose factors behind their purchasing intention of reusable building materials.

For establishing efficient market, reverse logistics, material availability by reuse mapping in Bodø a case study is significant to explore the idea of creating a comprehensive market design for reuse of construction materials that will sustain and bring remarkable changes on the practice of reuse of building materials in this city.

It would be useful to perform qualitative research on the comparison between Bodø and another Norwegian or Nordic city that has been adopting building material reuse as there might be different barriers of such implementation and the solution for these barriers will be significant insight for Bodø.

Although this could not be considered as a business research, another interesting strategy could be to make use of qualitative and quantitative studies for exploring the energy-saving potentiality of old building materials compared with virgin materials in making energy efficient building.

More information could also be gathered for knowledge building about regulative framework regarding the reuse of building components for construction sectors because the concerned actors in the construction sector require such knowledge for proper reuse of waste.

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Appendix 1. Interview guide

General Information:

1.Say something about your work and how long you have been working on it.

2.How does your work and company facilitate to the reuse potentiality of building component in Bodø city?

Significance of circular economy reuse

1.What do you mean by building material reusing?

2.How do you interpret; sustainable waste management of a potential smart and sustainable city Bodø should be done by adopting circular economy principle of reuse?

3. Bodø has environmental and climate goal (achieving climate neutrality by generating net zero emission) as part of their smart sustainable city planning. What can be the role of circular economy reuse in construction waste? What is your opinion?

4.Studies suggest that waste hierarchy says reuse option is comparatively less energy and resource intensive than recycling in construction material and to get credible circular position reuse should be taken in action, in what ways does your company put focus on reuse besides recycling while it is for building material?

5.Construction and building sector are in a leading position in generating emission, environmental footprint. What is your opinion about how can this sector contribute to accomplish climate goal and sustainability in Bodø?

Market Situation of Bodø/ Availability of reusable material, quality maintenance:

1.What is your opinion about Bodø's current market situation in this city for reusable building materials?

2. What is the easiest and greatest material to reuse among building material? Why?

3. How do you interpret the maintenance and certainty about the quality of the construction structure made from reused material compared with construction structure made from new material?

Consumer preference and Stakeholder's motivation:

1.What factors can influence consumer preference to buy reuse building material?

2.What can be the best motivation for stakeholders?

Success factors, opportunity, and potentiality in Bodø

1.How much is Bodø potential for building material reuse in city?

2. From your opinion what are the success factors and opportunity Bodø has already for increasing utilization of reusable building material in this city?

3. What do you think about the reuse of materials and its potential when we know that in Bodø construction material mostly come from import?

National and local policy and support:

1.What can you say about the national policy (both at the governmental, ministry) and local levels) in terms of implementing reuse of building component?

2.How does Bodø municipality support the activities related to reuse of building materials?

3. What is your opinion about Bodø municipality's way of execution and support in terms of building materials reusing?

Potential barriers and Way forward

1.What are the main potential barriers and practical challenges that are interrupting to establish this reuse material practice in broader way in this city?

2. What is the most hindering barrier among all the barriers that you have mentioned?

3. How do you think it is possible to overcome these practical challenges and main barriers to increase the utilization of reusable building component in near future? In what time frame?

Comment/opinion to add

1.Any comment and suggestions from your viewpoint for implementation reusable construction product in this city?

2.Your observation and prediction the reusable material market in Bodø within coming years

Appendix 2. Approval NSD

Assessment

Reference number	Type	Date
766645	Standard	25.03.2022

Project title

Assessment of regulatory barriers to reuse building material for construction waste management in case of making smart sustainable and climate neutral city

Data controller (institution responsible for the project)

Nord Universitet / Handelshøgskolen / Nordområdesenteret

Project leader

Elena Dybtsyna

Student

Ananya Chakrovorty

Project period

23.02.20220 - 22.02.2023

Categories of personal data

General

Legal basis

Consent (General Data Protection Regulation art. 6 nr. 1 a)

The processing of personal data can begin, so long as it is carried out as described in the Notification Form. The legal basis is valid until 22.02.2023.

Notification Form

Comment

ABOUT OUR ASSESSMENT

Data Protection Services has an agreement with the institution where you are carrying out research or studying. As part of this agreement, we provide guidance so that the processing of personal data in your project is lawful and complies with data protection legislation.

We have now assessed the planned processing of personal data. Our assessment is that the processing is lawful, so long as it is carried out as described in the Notification Form with dialogue and attachments.

TYPE OF DATA AND DURATION

The project will be processing general categories of personal data until the date documented in the Notification form.

LEGAL BASIS

The project will gain consent from data subjects to process their personal data. We find that consent will meet the necessary requirements under art. 4 (11) and 7, in that it will be a freely given, specific, informed and unambiguous statement or action, which will be documented and can be withdrawn.

The legal basis for processing general categories of personal data is therefore consent given by the data subject, cf. the General Data Protection Regulation art. 6.1 a).

PRINCIPLES RELATING TO PROCESSING PERSONAL DATA

We find that the planned processing of personal data will be in accordance with the principles under the General Data Protection Regulation regarding:

• lawfulness, fairness and transparency (art. 5.1 a), in that data subjects will receive sufficient information about the processing and will give their consent

• purpose limitation (art. 5.1 b), in that personal data will be collected for specified, explicit and legitimate purposes, and will not be processed for new, incompatible purposes

• data minimisation (art. 5.1 c), in that only personal data which are adequate, relevant and necessary for the purpose of the project will be processed

• storage limitation (art. 5.1 e), in that personal data will not be stored for longer than is necessary to fulfil the project’s purpose 0

THE RIGHTS OF DATA SUBJECTS

As long as the data subjects can be identified in the data material, they will have the following rights: access (art. 15), rectification (art. 16), erasure (art. 17), restriction of processing (art. 18), data portability (art. 20).

We find that the information that will be given to data subjects about the processing of their personal data will meet the legal requirements for form and content, cf. art. 12.1 and art. 13.

We remind you that if a data subject contacts you about their rights, the data controller has a duty to reply within a month.

FOLLOW YOUR INSTITUTION'S GUIDELINES

We presuppose that the project will meet the requirements of accuracy (art. 5.1 d), integrity and confidentiality (art. 5.1 f) and security (art. 32) when processing personal data.

If you use a data processor (online survey tool, cloud storage or online interview platform) the processing must meet requirements under arts. 28 and 29. Use a data processor that your institution has an agreement with.

To ensure that these requirements are met you must follow your institution's internal guidelines and/or consult with your institution (i.e. the institution responsible for the project).

NOTIFY CHANGES

If you intend to make changes to the processing of personal data in this project it may be necessary to notify us. This is done by updating the Notification Form. On our website we explain which changes must be notified: https://www.nsd.no/en/data-protection-services/notification-form-for-personal-data/notify-changes-in-the-notification-form0

Wait until you receive an answer from us before you carry out the changes.

FOLLOW-UP OF THE PROJECT

We will follow up the progress of the project at the planned end date in order to determine whether the processing of personal data has been concluded.

Good luck with the project!

Appendix 3. Consent form for the participants

Are you interested in taking part in the research project?

***(*Assessment *of regulatory barriers to reuse building material for construction waste management*?)**

This is an inquiry about participation in a research project where the main purpose is to [identify the regulatory and legislative barrier in case of reusing building and construction waste as part of waste management to make a smart sustainable city, Bodo city, situated in Northern Norway, is aiming to be smart and sustainable city in future and hopefully my thesis will bring insights for Bodo city which will enhance their journey to be smart and sustainable, climate neutral. In this letter we will give you information about the purpose of the project and what your participation will involve.

Purpose of the project

Current regulation and legislation to reuse building materials in Norway do not support the use of circular economy principle in construction waste management especially 'Reuse' which ranks the 2nd highest waste management option by circular economy literature. Bodo is an arctic city aims to be a climate neutral smart sustainable city and there existing project called new city new airport is an opportunity to reorganize this city in more sustainable way. Bodo has circular economy principle on their city planning for the vision of smart sustainable and climate neutral city. The purpose of this project is to identify the regulatory barriers in building component reusing if there are any which do not allow Bodo to reach in credible circular solution in building waste management.

Briefly outline the project's objectives / research questions

This thesis will bring out an assessment task whether current regulation and legislation in Norway is creating any barrier for practising one of the circular economy principles 'Reuse' in construction and building waste management in Bodo. The research question we selected as, how does reuse of building material contribute to make a smart and sustainable city? To answer this question, we will go through answering two questions. How is the market condition of reuse building material in Bodo and what are the potential barrier in practicing the reuse of building materials?

This is a master thesis project for individual student.

No, personal data will be used in master thesis purpose.

Who is responsible for the research project?

Nord University Business School

Nord University has collaboration with Bodo municipality. This thesis will be a smart part of enhancing this collaboration.

Why are you being asked to participate?

We need the people as sample who are relevant in this thesis project, and this will be randomly selected sample in Bodo region who are working in these field. We send inquiry to

whom we think their valuable information will be helpful for our success of thesis work and finding the truth.

What does participation involve for you?

We want to collect data by interview and will make questions considering the thesis work. Before interview we will send questions and in the interview date, we will take 1 hour or 45 minutes for asking questions and this conversation will be audio recorded. We will use all the data anonymously in report.

Participation is voluntary
Participation in the project is voluntary. If you chose to participate, you can withdraw your consent at any time without giving a reason. All information about you will then be made anonymous. There will be no negative consequences for you if you chose not to participate or later decide to withdraw.

We will fix the interview time considering your convenient situation.

Your personal privacy – how we will store and use your personal data

We will only use your personal data for the purpose(s) specified in this information letter. We will process your personal data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act).

Nord university business school is responsible for this data, me and my supervisor Elena Dybtsyna will have access on this data.

- All data will be used anonymously and only their occupation will be published in report, name age, region name will be avoided.

What will happen to your personal data at the end of the research project?

All the recordings will be deleted, and data will be published and analysed in anonymous form. The project will end on 22.02.2023.

Your rights

So long as you can be identified in the collected data, you have the right to:

- access the personal data that is being processed about you
- request that your personal data is deleted
- request that incorrect personal data about you is corrected/rectified
- receive a copy of your personal data (data portability), and
- send a complaint to the Data Protection Officer or The Norwegian Data Protection Authority regarding the processing of your personal data

What gives us the right to process your personal data?

We will process your personal data based on your consent.

Based on an agreement with Nord University, NSD – The Norwegian Centre for Research Data AS has assessed that the processing of personal data in this project is in accordance with data protection legislation.

Where can I find out more?

If you have questions about the project, or want to exercise your rights, contact:

- Nord University Business School.
- Project supervisor: Elena Dybtsyna

  Associate Professor, Nord University Business school and High North centre, Nord University

  Email: elena.dybtsyna@nord.no

  Mobile: +47 75 51 71 89

  Office: NV U101
- Student: Ananya Chakrovorty

  Student number: 342877

  Email: ananyachakrovorty@outlook.com
- Our Data Protection Officer: Toril Irene Kringen, Email: personvernombud@nord.no. **Phone +47 74 02 27 50.**
- NSD – The Norwegian Centre for Research Data AS, by email: (personverntjenester@nsd.no) or by telephone: +47 55 58 21 17.

Yours sincerely,

Elena Dybsyna

Project Supervisor

Management

Ananya Chakrovorty

Student, Master of science in Global Management

Consent form

Consent can be given in writing (including electronically) or orally. NB! You must be able to document/demonstrate that you have given information and gained consent from project participants i.e., from the people whose personal data you will be processing (data subjects). As a rule, we recommend written information and written consent.

- For written consent on paper, you can use this template
- For written consent, which is collected electronically, you must choose a procedure that will allow you to demonstrate that you have gained explicit consent (read more on our website)
- If the context dictates that you should give oral information and gain oral consent (e.g., for research in oral cultures or with people who are illiterate) we recommend that you make a sound recording of the information and consent.

If a parent/guardian will give consent on behalf of their child or someone without the capacity to consent, you must adjust this information accordingly. Remember that the name of the participant must be included.

Adjust the checkboxes in accordance with participation in your project. It is possible to use bullet points instead of checkboxes. However, if you intend to process special categories of personal data (sensitive personal data) and/or one of the last four points in the list below is applicable to your project, we recommend that you use checkboxes. This because of the requirement of explicit consent.

I have received and understood information about the project [insert project title] and have been given the opportunity to ask questions. I give consent:

- ☐ to participate in (insert method, e.g., an interview)
- ☐ to participate in (insert other methods, e.g., an online survey) – if applicable
- ☐ for my/my child's teacher to give information about me/my child to this project (include the type of information)– if applicable
- ☐ for my personal data to be processed outside the EU – if applicable
- ☐ for information about me/myself to be published in a way that I can be recognised (describe in more detail)– if applicable
- ☐ for my personal data to be stored after the end of the project for (insert purpose of storage e.g., follow-up studies) – if applicable

I give consent for my personal data to be processed until the end date of the project, approx. [insert date]

(Signed by participant, date)