

**ACTIONS AND ATTITUDES TOWARDS RECYCLING
- A STUDY OF FINNISH CONSTRUCTION
COMPANIES**

**Jyväskylä University
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ABSTRACT

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Title Actions and Attitudes Towards Recycling - A Study of Finnish Construction Companies	
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<p>Abstract</p> <p>Waste management has been around since the first societies were formed. However, it was only a century ago that waste was recognized a global problem and developing solutions to address this problem started. Building construction is a high energy and resource demanding industry which constitutes a significant amount of solid waste globally, about one third of global waste is generated by the construction sector. In 2008, the EU set a target to recycle 70% of construction waste by 2020, and with a 48% recycling rate Finland is behind this target. From July 2022 the waste act of Finland obligates construction companies to separately collect more waste fractions.</p> <p>Previous research suggest that actions and legislative measures need to be taken to improve recycling and that waste management need to be considered in the operations and strategy of construction companies. Earlier research also indicates that actions and attitudes affect one another. This study aims to discover actions taken by construction companies to ensure separate collection and enhance waste management. The actions connection to company strategy and the attitudes towards separate collection are studied as well.</p> <p>The results of this study show that the most preferred action taken is education and increasing knowledge. Some companies have waste management goals directly embedded in their strategy while with others the connection is indirect through their other environmental goals. However, the results indicate that all companies have the potential to improve their waste management strategies for better performance. The results also indicate that construction companies prefer to follow the rate of sorting wastes rather than recycling rate. Some change in attitudes towards waste management compared to previous research were discovered. These include attitudes towards waste reduction and higher level of management commitment. Finally, based on the results of this study a connection between strategy, actions and attitudes is proposed. This study provides insight on the current state of construction waste management in Finland as well as the different strategic level actions taken towards waste management in the construction industry.</p>	
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<p>Tiivistelmä</p> <p>Jätehuoltoa on ollut olemassa ensimmäisistä yhteisöistä lähtien. Kuitenkin vasta noin sata vuotta sitten jäte tunnistettiin globaaliksi ongelmaksi ja ratkaisuja sen hoitamiseksi alettiin kehittää. Rakentaminen on energiaintensiivinen ja resursseja vaatia toimiala, josta syntyy merkittävä määrä jätettä. Tämä vastaa noin kolmasosaa kaikesta jätteestä maailmanlaajuisesti. Vuonna 2008 EU asetti tavoitteeksi kierrättää 70 % rakentamisen jätteestä vuoteen 2020 mennessä. Suomi on jäljessä tästä tavoitteesta, koska tällä hetkellä rakennusjätteen kierrätysaste on 48 %. Heinäkuusta 2022 lähtien Suomen jätelaki vaatii rakennusliikkeitä lajittelemaan erikseen aiempaa enemmän jätėjakeita.</p> <p>Aiemmat tutkimukset kertovat, että kierrätysasteen parantamiseksi tarvitaan uusia toimintamalleja ja lainsäädäntöä. Jätehuolto pitäisi myös sisällyttää rakennusliikkeiden toimintaan ja strategiaan. Aiempi tutkimus viittaa myös siihen, että toiminnot ja asenteet vaikuttavat toisiinsa. Tämä tutkimus pyrkii selvittämään millaisia toimenpiteitä rakennusliikkeet tekevät erilliskeräysvelvoitteen eteen ja parantaakseen jätehuoltoa. Tutkimuksessa tarkastellaan myös toimenpiteiden kytkeytymistä yritysstrategiaan, sekä asenteita jätteen erilliskeräystä kohtaan.</p> <p>Tämän tutkimuksen tulokset osoittavat, että suosituin toimenpide on jätehuollon koulutus ja tiedottaminen. Jotkut rakennusliikkeet ovat sisällyttäneet jätehuollon suoraan strategiaansa. Toisilla se taas kytkeytyy strategiaan muiden ympäristötavoitteiden kautta. Tulokset viittaavat myös siihen, että rakennusliikkeillä on mahdollisuus parantaa jätehuollon strategioita ja kehittää toimintojaan entisestään. Tulosten mukaan rakennusliikkeet seuraavat mieluummin jätteen lajitteluastetta, kun kierrätysastetta. Asenteissa huomattiin joitakin eroja aiempaan tutkimukseen verrattuna, tämä näkyi esimerkiksi asenteissa jätteen vähentämistä kohtaan. Myös johdon sitoutumisen jätehuoltoon huomattiin olevan paremmalla tasolla kuin aiemmin. Lopuksi tulosten pohjalta esitetään kuinka strategia, toiminnot ja asenteet kytkeytyvät toisiinsa. Tämä tutkimus antaa käsityksen rakennusliikkeiden jätehuollon nykytilasta Suomessa sekä erilaisista strategiaan kytkeytyvistä toimenpiteistä rakentamisen jätehuollossa.</p>	
Asiasanat Jätehuolto, kierrätys, ympäristöstrategia, rakentaminen, asenteet	
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1 INTRODUCTION

1.1 Background

Building construction is a high energy and resource demanding industry which constitutes a significant amount of solid waste globally. According to the Finnish Ministry of the Environment around half of the use of natural resources and 40% of unrefined energy is used in buildings and the construction of buildings. Furthermore, about one third of global waste is generated by the construction sector. In the European Union (EU) the amount of construction waste (CW) is over one third of all waste generated (European Commission 2016). According to the Official Statistics of Finland the amount of CW compared to the total amount of waste generated in 2019 was 11.7%, however if excluding mineral wastes from mining industry, the percentage is as much as 48% (Official Statistics of Finland 2019). These figures show that CW plays a major part in waste generation, and it should be considered in the operations and strategy of construction companies. The amount of CW generated in Europe is growing yearly as the construction industry itself is growing (Dahlbo et al., 2015).

Previous research shows that waste management is not considered a material issue in the construction sector and suggests that legislative measure should be taken to improve waste management (Udawatta et al., 2015). Legislation is also suggested as a possible driver to improve recycling in the construction sector by Tam et al., (2018). Teo and Loosemore (2001) discuss that without management involvement and incentives a construction site is unlikely to put much effort to waste management. The authors continue to give suggestions that waste management policies should be created in company level as well as at a project level (Teo & Loosemore, 2001). Also, additional actions need to be taken to reach more effective recycling (e.g., Dahlbo et al., 2015 & Zhang et al., 2022).

Already in 2008, the EU set a directive that 70% of construction and demolition waste should be recycled as materials by 2020 (European Commission, 2018). However, the average recycling rate in the EU is around 50% (European Commission 2018). In Finland we are still a long way from the 70% target. In 2019, according to Circwaste (n.d.), the recycling rate of CW in Finland was 48%. However there has been a few cases achieving a recycling rate of over 70%, so it is not impossible to achieve (Tupala, 2020). New regulations to the waste act of Finland were enforced July 1st, 2022, requiring construction companies in Finland to sort more recyclable waste fractions on site (Levinen, 2021). This current enforcement of the new regulations gives a rare opportunity to study how legislative measures affect companies' actions and strategies towards waste management at the time of enforcement. It is also important to study if the attitudes have changed with the new legislation, in other words is waste management still considered not a material issue.

Three gaps in research concerning construction waste management have been identified. First, the timing of this research at the time of enforcing new regulations to separate collection, which is bound to affect the attitudes and actions construction companies are taking now. The timing suggests that research towards these issues is lacking, since the regulations are so new. Second, although waste collection and waste management performance have been studied to some extent (e.g., Dahlbo et al. 2015), to my knowledge there is no research of waste management actions and their relation to overall company strategies of construction companies in Finland. This Master's Thesis aims to bridge the first two research gaps by conducting the study at the time of enforcement of the regulations concentrating on actions taken towards waste management and their connections to company strategies. The third gap comes from existing literature. Teo and Loosemore (2001) suggest that it would be important to research the attitudes of managerial level towards construction waste management. Some research towards this exists, for example, Liu et al., (2019) have interviewed project managers about their attitudes in waste minimization, and Tam et al., (2018) have studied attitudes towards recycling. However, this study aims to bridge the third gap further, by looking into attitudes towards separate collection as well.

1.2 Research problem and structure of the thesis

I chose to do my Master's Thesis on this topic because it relates to my work with planning and selling waste management services to construction companies. In my work I have seen different attitudes towards waste legislation and multiple ways of dealing with waste management on construction sites. This especially can be seen in the separate collection of different fractions, some companies are really invested in separate collection, while some are not. Separate collection is seen to have a direct impact in improving recycling (Yuan et al., 2013). Separate collection also helps divert wastes away from landfills (Dahlbo et al., 2015).

I have observed that different construction companies have different in-house targets and the attitudes of the site managers towards recycling varies. According to Begum et al., (2019) attitudes towards waste management are more positive in companies where managers are invested in environmental issues. Therefore, I decided to conduct a study on actions taken on the organizational level with an interest to find out about attitudinal factors as well. The results of this research will provide insight on the current status of construction waste management in Finland as well as the different strategical level actions taken towards handling CW.

I was interested to find out what the attitudes of large construction companies are towards the new waste act and what kind of action has been taken or is in planning to achieve the European Union target of a 70% recycling rate and

fulfil the requirements of the new waste act. I chose to concentrate on the environmental management level. My own experience has shown me that companies where the management is invested in sustainability goals are more invested throughout the company and thus achieving better than average results in recycling.

Considering the above introduction and my own motivations, I felt it important to conduct a study of construction companies' attitudes and actions towards waste management at this time, when Finland is enforcing a new waste act that should improve construction waste management.

My research aims in answering the following questions.

RQ: What actions are taken to reach 70% recycling rate? And how the actions relate to company strategy?

RQ: What are the companies' attitudes towards recycling and separate source collection of different waste fractions?

In the next chapter I have conducted a literature review of previous research of the subject, and I introduce key concepts relating to my Master's Thesis. This is followed by the methodological choices for data collection and analysis. Thereafter I will continue to introduce the actual research followed by discussion and conclusions.

2 THEORETICAL FRAMEWORK

This section will introduce the key concepts of this Master's Thesis. First, it will dive into waste management in general and introduce the EU waste framework directive, including the waste hierarchy. The waste hierarchy gives foundation for this research because it is the basis of how waste management should be handled. The EU construction and demolition waste protocol will also be introduced. Continuing to a chapter explaining the key points of the Finnish waste act in relation to construction waste. The waste act was developed in accordance with the EU waste framework and thus is a relevant part of this section. The waste act also relates to one of the research questions of this Master's Thesis. This is followed by a review of previous research considering waste management in the construction industry. The review of literature gives an idea on where the construction industry stands at the moment in accordance with regulations and the EU directive. Thereafter, attitudes towards construction waste management are introduced, because behavior can be affected by attitudes, which can lead to either positive or negative outcomes in recycling and separate collection. Finally, environmental strategies are discussed and the importance of embedding them in overall company strategy. This part is important, since as already mentioned in the introduction of this study, management involvement is imperative to succeed in waste management and without management involvement waste management is unlikely to end up as a strategical goal of a company.

2.1 Waste management

A brief introduction to waste management in general is in order, since this study strongly relates to waste practices. This chapter gives a short history of waste management, its development and briefly discusses the environmental impacts of waste.

Waste has been around as long as societies have existed, and some form of waste management has been around long before air pollutants or climate change have crossed our minds (Chandrappa & Das, 2012). According to Chandrappa and Das (2012) complications due to waste can be dated to ancient eras and the composition of waste has changed over time in accordance with new product and technological development. Nonetheless the composition, quality and amount of waste also is dependent of socioeconomical factors such as income and culture not forgetting a regions economic situation (Mendoza, 2019). It was not until early 1900's that waste was recognized as a global problem affecting habitats around the globe and solutions for the problem started to arise (Mendoza, 2019). This development took its time to reach different areas, and for example it was not until 1976 that South Africa established its first institute of waste

management (Mendoza, 2019). Chandrappa and Das (2012) continue to argue that waste is one of the environmental problems arising from development and defines waste as some material that is unwanted at the time of generation with no immediate use as such.

The European Union (2008) gives a simple definition to waste as any material or item that is discarded or intended or required to be discarded by its owner. Waste management is defined as the collection, transportation, retrieval and discarding of waste encompassed with the management and supervising of those operations, and the handling and management of disposal sites (European Union, 2008). Mendoza (2019) defines industrial waste as solid components generated by an industry that are not a part of municipal waste collection and excludes hazardous and radioactive waste. Mendoza (2019) continues to discuss that the generation of different types of wastes varies and thus waste management is challenging and still today waste management consists mostly of methods of recovery, recycling, and disposal. These methods are also introduced by Chandrappa & Das (2012) adding waste treatment on the list. These methods are introduced more definitely in chapter 2.2. below.

Waste plays a major role in environmental protection (Mendoza, 2019). The overuse of natural resources has proven to endanger the natural environment and poses grave impacts to ecosystems (Mendoza, 2019). Therefore, environmental protection has become an ever-growing concern to organizations and governments, not forgetting the individuals as well (Mendoza, 2019). Waste generates several different pollutants that affect air, water, and land (Mendoza, 2019). Chandrappa & Das (2012) argue that the environmental impacts transpire in all stages of waste management and therefore appropriate waste management will mitigate environmental impacts of waste, however not eliminating them completely.

2.2 EU waste framework directive and guidelines

The research questions of this study are related to legislation and governmental goals, which are derived from the EU waste framework directive and waste hierarchy, this chapter will introduce the focus of the directive with a more detailed emphasis given to the waste hierarchy. Thereafter, EU guidelines for construction waste management is discussed.

In 2008 the EU set out to develop a directive to guide waste management in its member states. Over the years the directive has been updated many times. The main purpose of the waste framework directive is to prevent and mitigate negative impacts of waste generation and management of waste. The objective is to improve resource efficiency and reduce the impacts of resource utilization in general, thus protecting health, wellbeing, and the environment. The directive also suggest that member countries develop their waste policies in a transparent way while considering sustainability and environmental protection principles.

Technical possibilities and economic feasibility are also considered when developing waste management as well as the total social, economic, and environmental impacts. (European Union, 2008)

The directive gives a set of different guidelines towards waste management (European Union, 2008). A waste hierarchy (Figure 1) has been applied to give a priority order to guide legislation and waste policies of member countries (European Union, 2008). The waste hierarchy sets a base for member states to follow when considering options in their policy and legislation with the aim to deliver the greatest environmental outcome (European Union, 2008). The goal for recycling set by the waste framework directive is as follows *“by 2020, the preparing for re-use, recycling and other material recovery, including backfilling operations using waste to substitute other materials, of non-hazardous construction and demolition waste excluding naturally occurring material defined in category 17 05 04 in the list of waste shall be increased to a minimum of 70 % by weight”* (European Union, 2008, art 11;2b).



Figure 1. Waste hierarchy. Adapted from European Commission Waste Framework Directive (European Commission, n.d.).

The waste hierarchy consists of five steps, that are arranged from top to bottom with the most preferable option on top at the first step and the least preferable option at fifth step in the very bottom. Steps two to four are highlighted in the figure above, because they are the main implementations of today's waste management according to Mendoza (2009). European Union (2008) asserts that member states are obligated to plan and enforce actions that are following the preferred order of the waste hierarchy. Aspitz (2010) states that the waste hierarchy is expected to be a key driver in regulation formation and can help in assessing sustainability. Here the levels and their meanings in will be explained in detail.

The first step, Prevention, has two aspects to it. It means the actions taken to mitigate the harmfulness and harmful impacts towards health and the environment caused by the waste generated and the reduction of the quantity of waste by making longer lasting products with extending their lifespan (European Union 2008). These actions are taken before any material becomes waste (European Union 2008). According to Zhang et al. (2022) prevention of waste is the most important principle of the hierarchy. Mendoza (2019) narrowly defines prevention to consider actions taken by producers of waste aiming in reducing the amount of waste generated.

Preparing for re-use, the second step in the hierarchy means cleaning, checking, recovering, and repairing of products or parts of them to re-use them as such (European Union, 2008). The re-use of products does not include processing the components or products (European Union, 2008). This is seen as difficult to some extent, yet a promising measure in the future (Zhang et al., 2022). A good real-life example of preparing for re-use is the collection, fixing and re-selling of wooden pallets in Finland, where the re-used pallets lower the carbon footprint, wood waste and the use of virgin raw materials (Lassila & Tikanoja, 2021).

The third step is recycling, which is the recovery and reprocessing of wastes and materials for the use in some other purposes, or the original purpose of the materials (European Union, 2008). Recycling includes the reprocessing methods to materials but leaves out the repurposing for energy or materials that are made into waste-based fuels (European Union, 2008). Recycling does not include backfilling operations either (European Union, 2008). Backfilling is the use of waste materials for landscaping (European Union, 2008). Zhang et al. (2022) argue that recycling depends on a variety of factors such as end-of-life conditions, promotion and selling of secondary materials, treatment effectiveness to name a few. The authors also believe recycling to be an important mean towards a circular society (Zhang et al., 2022). A lot of different materials can be and are already recycled, metals, paper, plastics and cardboard for example (Zhang et al., 2022). Recycling is considered to help mitigate the use of virgin raw materials or even replace them in (Hultman & Corvellec, 2012).

The fourth and fifth steps are recovery and disposal. Recovery is about replacing other materials with waste and thus lowering the use of virgin raw materials or fossil fuels by using waste to produce energy (European Union, 2008). Simply put, recovery is the usage of waste materials by incinerating them to produce energy (Hultman & Corvellec, 2012). The least preferable option is disposal, which means an operation that is not recovery, landfilling or releasing waste to a body of water are ways of disposal (European Union, 2008).

Construction and demolition waste is the biggest waste stream in the EU by volume. In 2016 the European Commission has published a non-binding set of guidelines, the EU construction and demolition waste management protocol, for the construction industry to provide means for better waste management within the industry. It concludes that an effective and proper treatment and management of this waste stream can have tremendous benefits for sustainability and

quality of life. The Commission also suggest that proper treatment of construction waste would likely increase the demand for recycled construction materials, however one obstacle for the use of recycled construction materials is the lack of trust for the quality of such materials. At the moment this lack of trust limits the demand of recycled materials and thus prevents or slows the development of waste management infrastructure in the EU. (European Commission, 2016)

The protocol is in line and a part of the EU Circular Economy Package which was presented to help transition towards a competitive circular economy. The guided activities from the protocol will help construction companies in reaching the 70% recycling target from the waste framework directive and strive towards closing loops in product life cycles by enhancing the recycling and re-using of construction materials, therefore profiting the environment as well as the economy. The main purpose of the protocol is to intensify and grow trust in recycled materials and grow confidence in the waste management process. Reaching this target demands five components given in the protocol, which are improved waste identification, source separation and collection; improved waste logistics; improved waste processing; quality management; appropriate policy and framework conditions. (European Commission, 2016)

The above protocol, which helps member countries in developing more consistent waste practices is important since there are also studies naming problems with the EU target of 70% material recovery. For example, Arm et al. (2017) conclude that member states have differences in understanding definitions of waste and recovery, which leads to inconsistencies in reporting environmental effects. Arm et al. (2017) continue to point out that the EU target is weight based and this leads towards favoring heavier streams of waste that are recyclable, therefore rendering the smaller waste streams insignificant. Finally, Arm et al. (2017) present that better understanding of waste management is needed to reach recovery that is sustainable.

2.3 Construction waste in the Finnish waste act

The Finnish waste act, which is largely derived from the EU waste framework directive introduced in the previous part, requires constructions companies to follow certain obligations. The parts of the waste act concerning the construction industry is presented below. Legal requirements also drive companies' strategical decisions related to compliance. However, strategies will be discussed more in detail in chapter 2.6.

According to the current waste regulations in Finland the target is to recycle 70% of CW as materials (Levinen, 2021). Considering the current recycling rate, reaching this goal will take much effort and actions (Levinen, 2021). The new regulations consist of broad and strict separate source collection obligations (Levinen, 2021). There are eleven material types to be collected separately which are

1) Concrete, tiles, ceramics; 2) Asphalt; 3) bitumen and roofing felt; 4) gypsum; 5) wood, excluding impregnated wood; 6) metals; 7) glass; 8) plastics; 9) paper and carton; 10) mineral wool; 11) soil and rock (Finlex, 2021).

Whoever will start a construction project is obligated to follow the waste hierarchy to minimize the amount and harmfulness of waste and ensure the re-use and recycling of most materials. The producer of waste is obligated to arrange separate collection of at least the fractions mentioned in the waste act on site. The source collection applies also to other recyclable fractions if they are generated in large homogenous amount. They are also responsible to arrange the collection of these separate fractions in a way that they will be delivered to treatment that will ensure efficient preparing for re-use or recycling. This regulation aims to guarantee efficient utilization of CW materials and to ensure high quality of recycled materials. (Levinen, 2021)

Levinen (2021) realizes that separate collection can increase the cost of waste management and it possibly proves to be difficult because construction sites often have confined limited space. However, Levinen (2021) continues to discuss that careful separations of fractions reduces the amount of mixed waste which might in the end provide to lower the overall cost of waste management. The new regulation also obligates construction companies to report the amount of CW generated (Levinen, 2021). These reports should also include re-used and recycled materials, giving supervising authorities the possibility to calculate the rates of re-use and recycling (Levinen, 2021). These reports will help follow if set targets are achieved. Furthermore, the data can be used in statistical analysis, development of waste management and circular economy as well as research (Levinen, 2021).

2.4 Waste management in construction industry

This chapter will introduce recent research in construction waste management. Furthermore, it will introduce CW's relation to circular economy and finally continue with CW management in Finland.

In the EU, construction generates the largest amount of waste as an industry sector (Zhang et al., 2022; Giorgi et al., 2022). Chen et al., (2022) explains the vast amounts of waste is owed to the industry's fragmented value chains, stakeholder diversity and the complexity of construction projects. The construction industry's wastefulness drives the EU to strive towards circularity in construction waste management (Zhang et al., 2022). The total amount of CW, including waste from demolition operations amounts to a staggering 850 million tons annually, and amounts to 35% of all waste generated in the EU (Villoria Sáez & Osmani, 2019). Urbanization and economic growth are expected to grow in the future, thus correspondingly growing the amount of waste generated (Wahi et al, 2016). Proper management of CW is needed to prevent this vast amount of waste

having a damaging effect towards the environment (Wahi et al., 2016). The construction industry is one driver in the environmental crisis going on globally which has led to efforts to prevent and mitigate CW in an international, regional, and local scale (Villoria Sáez & Osmani, 2019). However, it seems the reason construction companies take environmental action is often based on meeting the clients demands or pressure from the public (Teriö et al. 2014). Villoria Sáez and Osmani (2019) point out that CW recovery varies from as little as 10% to more than 95% in different EU countries. Likewise, CW management practices and monitoring of recycling differs in different EU states for various reasons, such as infrastructure in recycling, legislation, construction practices and local differences (Villoria Sáez & Osmani, 2019). A study by Giorgi et al., (2022) on five EU countries CW policies point out that the current legislation focuses more on recycling than reuse or management of resources.

A share of recent research on construction waste management (e.g., Diemer et al., 2022 and Tomić & Schneider 2020) deals with the concept of circular economy (CE), therefore a narrow definition of CE is in order. Both Sitra (n. d.) and the European Parliament, (2022) define CE as a model that expands life cycles of products and materials. Furthermore, in CE the focus from producing excess amounts of new products, attention is shifted from owning products to sharing, leasing, renting, repairing, refurbishing, and recycling them (European Parliament, 2022). Ellen MacArthur Foundation (n. d.) bases CE on three principles: Eliminate waste and pollution; circulate products and material; regenerate nature. The previously introduced construction and demolition waste protocol is also a part of EU's circular economy package (European Commission, 2016).

With the EU economy under duress from overgrowing its own production of raw materials, relying on imported materials, due to fast progress and development (Tomić & Schneider, 2020). EU is emphasizing the need for a more efficient and sustainable economy (Tomić & Schneider, 2020). The circular economy package introduced by EU highlights the importance of waste recovery and avoidance of waste (Tomić & Schneider, 2020). Del Río Merino et al, (2010) argue that the growing amount of CW combined with the fact that many EU countries are behind the recycling targets drives and motivates the need for new waste management strategies and systems. Essentially developing new waste management procedures and substantial changes to the waste management system are needed to reach the targets set by EU (Tomić & Schneider, 2020).

According to Diemer et al., (2022) reaching circularity in the construction sector rests highly on enforcement of legislation, however the role of private companies adopting circular economy principles proactively plays a major role as well. Zhang et al., (2022) discuss that both the waste hierarchy and CE give incentive for new ways of waste management, where redesigning products in a way that mitigates negative effects of waste and increases the efficient use of resource throughout the products life cycle. Zhang et al., (2022) continue to point out that one key stage towards CE is recycling in a way that the value and quality of materials are not compromised. Furthermore Zhang et al., (2022) address the importance of separate collection of different CW materials on-site to guarantee

the quality of waste materials. Yuan et al., (2013) has identified that separate collection of CW directly improves recycling. More well-organized source separation would divert waste away from landfills thus lowering negative climate impacts (Dahlbo et al., 2015). Dahlbo et al., (2015) discuss the importance of source separation further by pointing out that more easily recyclable materials should be recovered from mixed waste by source separation, lowering the negative impacts of construction operations even further. There are also problems identified with implementing separate collection of waste, for example before a culture of recycling has been established on the construction site, continuous supervision of separate collection is needed to make sure that separated wastes are not contaminated with other waste materials (Boser & El-Gafy, 2011).

Tam et al., (2018) and Gálvez-Martos et al., (2018) discuss the importance of proper planning of waste management practices early, even before the actual construction begins. Planning is time saving and less costly because more issues can be accounted for when planning waste management properly (Tam et al., 2018). The authors point out that with advance planning construction companies can especially reduce the amount of waste, because planning procedures properly leads to less excess materials (Tam et al., 2018). Mbadugha et al., (2021) also discuss the importance of recognizing early on the factors and processes that generate waste in order to enhance waste reduction. Reducing waste in construction industry needs improvement in current waste management practices (Mbadugha et al., 2021). Zu Castell-Rüdenhausen et al. (2021) point out that if there is lack of planning the procedures for waste management and waste reduction early on in the construction project it will have a negative effect on waste generation during the whole project.

In Finland the construction industry is generating substantial amounts of waste (e.g., Teriö et al., 2014 & Liikanen et al., 2019). However, Finland is falling short of the 70% of recycling construction waste as materials and additional measures need to be considered to reach this target (Liikanen et al., 2019). In their study Liikanen et al., (2019) analyzed the composition of mixed construction waste reaching the conclusion that there is potential to achieve a far greater recycling rate. However, Dahlbo et al., (2015) point out that the composition of waste generated on construction site varies depending on site, location, and construction materials, rendering it impossible to give a general composition to the waste. Teriö et al., (2014) discuss the importance of proper sorting of waste allows for more materials to be re-used or recycled and minimizes the amount of waste ending up in landfills.

2.5 Attitudes towards construction waste management

Attitude research is vast and diverse. Below is a definition of attitudes and a review on research of attitudes towards construction waste management.

Attitudes and intentions affect how people behave and by clarifying intentions, behavior can be affected positively on the direction that is intended (Olson & Zanna, 1993). Teo and Loosemore (2001) describe that, attitudes are formed to support structure and help prioritize the complexities of the world, while giving a degree of steadiness and clearness to a person's view of interpreting situations. According to Olson and Zanna (1993) no universal definition of attitudes exist. However, as this Master's Thesis is not about the psychology of attitude formation the above definition is sufficient.

Attitudes towards construction waste management are dependent on experiences, if someone has worked on a construction site where the outcome of waste management has been successful, they most likely have a positive attitude towards waste management and vice versa (Teo & Loosemore, 2001). Tam et al., (2018) argue that even though the attitude towards recycling is positive in the construction industry, behavior suggests otherwise.

A study done in Malaysia found that generally large construction companies have more positive attitudes towards waste management than small and medium sized companies. The authors also argue that companies which are invested in waste reduction measures are more positive about waste management. On top of these there are several factors contributing to positive attitude towards CW management. These are, for example participation in waste management training programs, overall experience in construction works. Organizational culture and waste management policies also plays a major role. (Begum et al., 2009)

Another research focused on attitudes towards waste minimization in China and the United States of America shows little difference in attitudes between the two countries and that there is behavioral intent towards CW minimization found with construction workers. The authors also address the importance of training and education of waste management to improve knowledge to improve attitudes and practices of waste minimization. (Liu et al., 2019)

At least one research also discusses that construction industry is driven by money, even though there are movements to more environmentally friendly operations, construction companies have the tendency to practices according to financial gain. The authors point out the difficulty in comparing environmental gain with financial gain which leads them to conclude that waste management decisions are often made financially because of the competitive nature of the industry. (Udawatta et al., 2015)

The authors continue to discuss the construction workers perceive waste management as an activity that is not important and are not interested in waste management. The authors also point out that there is not enough knowledge of the possible value of waste materials and no incentives to implements proper waste management for the construction companies. The authors conclude the general attitudes of construction companies are negligent towards waste management the focus should be on changing said attitudes. (Udawatta et al., 2015)

Teo and Loosemore (2001) have identified barriers that are obstructing construction companies in implementing waste reduction practices into their operations. From these barriers they have created a framework, based on Ajzen's

theory of planned behavior, for construction waste behavior, called the expanded theory of planned behavior (Figure 2).

In addition to attitudes there are two more factors that affect behavior. Subjective norms, which are for example social pressure and other social factors that reflects on individual behavior, and perceived behavioral control, which is how an individual perceives performing tasks, as easy or difficult. These perceptions are often derived from past experiences and anticipation of obstacles in performing the task. (Teo & Loosemore, 2001)

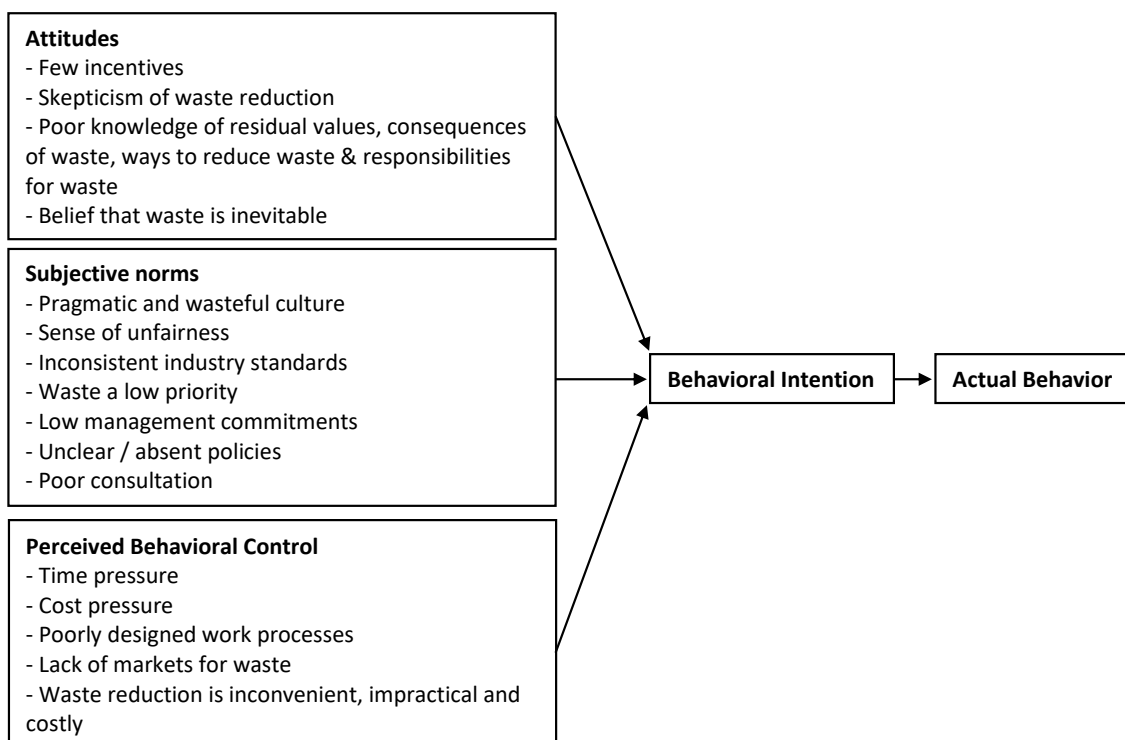


Figure 2. Expanded theory of planned behavior. (Teo & Loosemore, 2001).

Teo and Loosemore (2001), along with other researcher (e.g., Liu et al., 2019, point out the importance of knowledge and education of waste management practices. Advantages of proper waste management practices should also be related to safety and other project goals (Teo & Loosemore, 2001). Teo and Loosemore (2001) also argue that construction workers are not likely to put a lot of efforts in waste management unless the managerial level commits towards these issues giving incentives and resources towards it. The authors continue with a suggestion that waste management strategies should be created at a company level (Teo & Loosemore, 2001). The importance of embedding environmental goals to overall company strategies, in order to succeed in reaching the goals will be discussed next. The reason for discussing environmental strategies, rather than waste management strategies, in the next part is simply because there is more research done from environmental strategies, and therefore reviewing

those gives a more comprehensive picture than reviewing waste management strategies.

2.6 Environmental strategies

This chapter gives examples of the importance in embedding environmental or sustainability strategies to overall company goals and strategy. There is a lot of research from this area and here is a revision of some to give a general idea towards these issues.

According to Baumgartner and Rauter (2017, 81) “*Sustainable development refers to an economic, environmental and social development that meets the needs of the present and does not prevent future generations from fulfilling their needs*”. Furthermore, Solovida and Latan (2017) discuss the attention environmental responsibility is gaining because of environmental accountability and environmental impacts. The authors continue to argue that this has led company managers to develop environmental strategies to enhance their environmental performance (Solovida & Latan, 2017). Baumgartner and Rauter (2017) state that all companies have a responsibility to act or not act towards sustainability, because all companies affect the environment in some way. Comparing strategies between organizations can identify best practices and lead to improvements in strategical choices and the actions derived from strategies (Shooshtarian et al., 2020). Furthermore, comparison can also reveal inconsistencies between different strategies (Shooshtarian et al., 2020).

The question arises how much companies consider their environmental goals and how they relate to other corporate goals (Baumgartner & Ratner, 2017). There is also a desire to integrate sustainability issues to corporate strategy and this is necessary to achieve business value (Baumgartner & Ratner, 2017). However, while these issues have been discussed for a while, only limited real results can be seen in corporate sustainability (Baumgartner & Ratner, 2017).

Bocken et al. (2014) argue that the whole purpose of business must fundamentally change, and business models redesigned to reach sustainability. It is necessary to raise awareness in order to adopt sustainable business models and combine them with overall business models to achieve set goals (Bocken et al. 2014). Solovida and Latan (2017) discuss that the process of constant advancements in environmental actions needs improvements in the awareness, knowledge, and expertise of employees as well as commitment from managers. Integrating environmental matters into company strategy is also required and communication of these matters throughout the company (Solovida & Latan, 2017).

Management involvement with environmental matters directly affects to the organization’s capability in developing an environmental strategy that proactively goes beyond regulations and sheer compliance. Environmental performance is also affected positively and results from having a good environmental

strategy. How the strategy is implemented will also have an apparent effect on the company's environmental performance. (Solovida & Latan, 2017). As discussed in chapter 2.5. management involvement is considered also a material issue considering attitudes towards waste management.

3 DATA AND METHODOLOGY

The aim of this Master's Thesis is to explore a what construction companies are doing towards waste management and what are their attitudes towards it. Therefore, it was natural to let the representatives of the organizations to describe the phenomenon in their own words and qualitative approach was chosen to conduct this study. This chapter will introduce the chosen approach and methodology related to this Master's Thesis. Finally, it will describe the data collection and methods of analyzing the data.

3.1 Research methods

Qualitative research usually attempts to comprehend a phenomenon in the point of view of the subjects of the research. In qualitative research the researcher also tries to understand the thoughts, experiences and feelings given by the subject of the research to the phenomenon researched. However, it is impossible to fully comprehend someone else's thoughts and therefore, several different methods have been created to ease the effort of researcher to reach conclusions. Methods are usually referred to when explaining the various ways of collecting data for the research and how the data is analyzed. (Puusa & Juuti, 2020)

One characteristic of qualitative research is to approach the research subject in a natural state and, with the researcher's point of view combined to the subjects' experiences, give a theoretically sound presentation of the phenomenon researched (Puusa & Juuti (2020)). The natural setting is also important for the researcher to grasp the meaning and thorough understanding of the phenomenon studied (Saunders et al., 2019). The researcher's point of view and understanding of the data plays a major role in the presented results, therefore qualitative research is dependent of individual experiences (Puusa & Juuti, 2020). Gaining access to the research subject is crucial to the success of the study in order to build trust for gaining perceptive understanding of the data given by the subject (Saunders et al., 2019).

It is important to reach the research subjects' viewpoints as accurately as possible and it is appropriate to use methods that will bring the these up as good as possible. Therefore, different observation and interview methods are typical in qualitative research. Readily available data can also be used such as newspaper articles or biographies. (Puusa & Juuti, 2020)

In qualitative and organizational research different interview methods are most used data collection methods. An interview is an interaction between its participants, and it is important to know that the participants always influence each other. An interview aims to collect conscious and thoughtful information

that gives the opportunity to present trustworthy conclusions of the phenomenon researched, therefore it is necessary to record the interviews to keep the data conclusive. (Puusa & Juuti, 2020)

Different methods for interviews exist. Interviews can be structured, semi-structured, individual or group interviews. Depending on the phenomenon the researcher must decide which type of interview is most suitable to get the necessary data. Different types of interviews have a different relation for the phenomenon and thus, affects the results of the research. (Puusa & Juuti, 2020)

In this Master's Thesis semi-structured interviews were chosen as the method for data collection and therefore, it will be described in more detail. In semi-structured interviews the questions and the order they are presented are defined before the interview (Puusa & Juuti, 2020). The benefit of semi-structured interviews is that it leaves the freedom for the subject to answer in their own words and perceptions of the question asked, which might also give insight to information previously undetermined by the researcher (Puusa & Juuti, 2020). Semi-structured interviews give the researcher the opportunity to ask the subject to explain their answer more, which leads to a more in-depth answer and better data quality (Saunders et al., 2019).

When designing semi-structured interview, the researcher must have good knowledge of the topic in question and therefore, a literature review of previous research is needed. Reliability to answers can be promoted by giving a list of topics that will be covered in the interview in advance to the subject. This will permit the participant to prepare themselves beforehand and they will more likely provide better data. (Saunders et al., 2019)

According to Saunders et al., (2019) there are concerns about reliability of data collected through semi-structured interviews, that they might not be repeated, nor the same conclusions reached by other researchers, due to lack of standardization. However, it might also be argued that this type of research is not intended to be repeated in accordance with the results, because the results are dependent on of the situation and time the interview was conducted (Saunders et al., 2012). Puusa & Juuti (2020) discuss that data collected with a semi-structured interview can be affected by the researcher own views so much, that it is not reliable anymore. Therefore, the data must be analyzed by reflecting own experiences, understanding and knowledge of the topic with critical analysis, with an aim to provide the audience of the research subjective reasonings from the researcher in order to keep the finding reliable (Puusa & Juuti, 2020).

There are three approaches to qualitative research, deduction, induction, and abduction. In deductive reasoning existing theories are explored to develop a hypothesis and data collected to test this hypothesis. In inductive reasoning data is collected to explore a phenomenon and identify themes. Inductive reasoning also aims to develop an untested theory through the analysis of the data. In abduction the aim is to create a new theory or modify an existing one from the data collected, by exploring, testing and re-testing the theory with additional data. (Saunders et al., 2019)

In this study deductive and inductive reasoning are both used partially. The data is analyzed using inductive reasoning, while the existing research review show characteristics from deductive reasoning. However, the focus of chapter 2 is not creating a hypothesis, but rather give a thorough understanding for the reader to the topic researched.

3.2 Data collection

This Master's Thesis studies organizational actions and attitudes and therefore, semi-structured interview was a good choice because the freedom of answers gives a more in-depth view of the topic researched. Before forming the interview questions a literature review of previous research was done, as well a study of regulations related to the subject, to form a comprehensive understanding of the topic.

After the interview questions were formed it was time to select the subjects for the interviews. The interviews were done in cooperation CICAT2025 project, with two doctoral students as a part of a wider research to circular economy practices within construction companies. CICAT2025 is a multidisciplinary project of several Finnish universities that aims to help transition to circular economy (CICAT2025, n.d.). The companies for the research were chosen by revenue, the largest construction companies in Finland. This was done in the belief that larger companies have more experience in the topics discussed in the interview, since they have covered more construction projects than small and medium sized companies. The companies were also limited to companies that are involved in new construction building. Demolition and renovations was left out of this research.

The person from the company was chosen to be of management level with the responsibility and knowledge of the company's environmental management. Since there were a lot of variation in the work titles of the interviewees and a limited number of large construction companies, the titles are left out to keep anonymity of the research intact. The privacy of the interviews was explained to participants at the time of agreeing on date for the interview and in the letter sent with the invitation and link to the interview, and once more before the interview started. The researcher's personal network, work colleagues, social media and the companies' websites helped in choosing the right persons for the interviews.

The interviewees were contacted by phone and email if not reached by phone. Calling the potential participants was seen as a good option for getting as many participants positive answer as possible. The interviews were done with online video platforms, Zoom and Microsoft Teams, for the convenience of participating from different geographical locations. The interviews were conducted in Finnish to ensure mutual understanding of discussed topics and minimize the chance of poor quality of data due to misconception of questions asked. Interviews were conducted between May 25th and August 12th, 2022.

The actual interview consisted of four parts, with the first three covering issues related to circular economy and the fourth part in waste management strategies. The fourth part forms the data for this Master's Thesis and the first three parts are excluded from this study. The fourth part of questions started with this introduction *The national objective is to recycle 70 percent of construction wastes as materials and with the new waste act separate collection of certain waste fractions is obligated from July first, 2022* and was followed by these questions.

1. What actions have you taken to reach the recycling goal and to fulfill separate collection obligations?
2. What kind of actions have been planned to achieve these goals?
3. Does the company have internal goals for recycling and how do they connect with company strategy?
4. How are the goals monitored in Your company?
5. Have You noticed differences with Your own goals compared to developers' goals? (for example certified buildings, BREEAM, LEED)
6. How can You affect minimizing waste and the re-use of waste?
7. What challenges does separate collection create to construction sites and employees?
8. What kind of sentiments has risen from separate collection on construction sites?

Below, Table 1, shows the dates when the interviews were conducted and the duration of the interview.

Table 1. Interview dates and durations.

No	Company	Date of the interview	Duration in minutes
1	Company A	June 23 rd , 2022	47
2	Company B	June 22 nd , 2022	50
3	Company C	June 21 st , 2022	71
4	Company D	June 13 th , 2022	66
5	Company E	June 9 th , 2022	64
6	Company F	August 12 th , 2022	26
7	Company G	May 25 th , 2022	64
8	Company H	June 23 rd , 2022	59
9	Company I	June 3 rd , 2022	49
10	Company J	July 1 st , 2022	51

3.3 Data analysis

The interviews conducted makes up the primary data for this research. The interviews were recorded to keep them intact and reliable. The recordings were then transcribed into text. The transcribing of the interviews was outsourced to a company specialized in confidential transcribing.

According to Saunders et al. (2019) choosing an approach for analyzing qualitative data can be difficult since so many different methods exist and they are not exclusive from one another, that is multiple methods can be used simultaneously and the techniques of the methods might overlap each other. After careful consideration thematic analysis was chosen as the primary approach for analyzing the transcripts. Saunders et al. (2019) describe thematic analysis to be a systematic way of analyzing data which aims in finding themes that are repeated across the data set. In thematic analysis the researcher identifies the themes, codes them, and analyzes them further in relation to their research questions, it can be used to analyze both large and smaller samples of data (Saunders et al., 2019). In an inductive approach the themes are derived from the data, compared to a deductive approach where the themes would be derived from existing theories (Saunders et al., 2019). This is the main reason for choosing inductive approach, as mentioned in the introduction, there is a gap in existing research on this topic. Another reason for choosing thematic analysis is that it can be used to understand human attitudes and actions behind the reasoning that the data provides (Saunders et al., 2019).

Saunders et al, (2019) describes the procedure of thematic analysis to consist of four elements: becoming familiar with the data, coding the data, searching for themes, and recognizing relationships in them and finally, refining the themes and testing propositions. However, as Saunders et al. (2019) describe that the process is not a linear one, rather a back-and-forth process where the researcher redefines and re-classifies the themes continuously as the data is being analyzed. The analysis in this study follows these guidelines.

The transcribed answers were read over and over for the author to become familiar with the data and preliminary codes and preliminary categories were formed while going through the transcripts. According to Saunders et al. (2019) the main reason for conducting thematic analysis is to find patterns and themes from a set of data. The aim of analyzing the data was to find themes relevant to this research. Overall going through the transcripts and forming the preliminary codes was time consuming. However, it was also rewarding since the more going through the data the more familiar the author got, and the more precise categories were formed. The codes were formed to group up similar topics found in the transcripts. In a way getting familiar with the data and coding the data was done simultaneously. Coding is important for the author to form a better understanding of the data (Saunders et al. 2019). According to Saunders et al. (2019) coding helps the author to group up similar data with similar meanings, thus making it easier to move to the actual theming of the topics. Saunders et al. (2019) continue

to explain that codes are formed to summarize the meaning of the finding from the transcript.

When the data started to feel familiar enough the author started to form themes from the codes. Although, according to Saunders et al. (2019) the author already searches for themes and relationships while coding the data. At this point of preliminary analysis there were more than two hundred codes under fourteen preliminary categories. Approximately 15 to 35 codes were generated from each interview.

All the codes were written in an Excel sheet to keep them together and making it easier to compare them and find similarities in one glance. The research questions were also written on top of the Excel sheet to keep the focus of the analysis intact. It is important to go back and refer to the research questions and research aim to keep the analysis focused on the right direction (Saunders et al., 2019). According to Saunders et al. (2019) a theme should be broad and can include several codes related to each other, which are relevant to the research. After going through the initial codes and re-organizing them, the codes were reviewed all the while doing this and irrelevant codes were discarded. Themes started to form and going through the themes some closely related themes were found and these overlapping themes were joined under one theme. This is the fourth step of thematic analysis and according to Saunders et al. (2019) it is likely that going through the themes and refining them some will be combined to form new themes. Figure 3. gives an example of how the codes were formed and derived into the final theme.

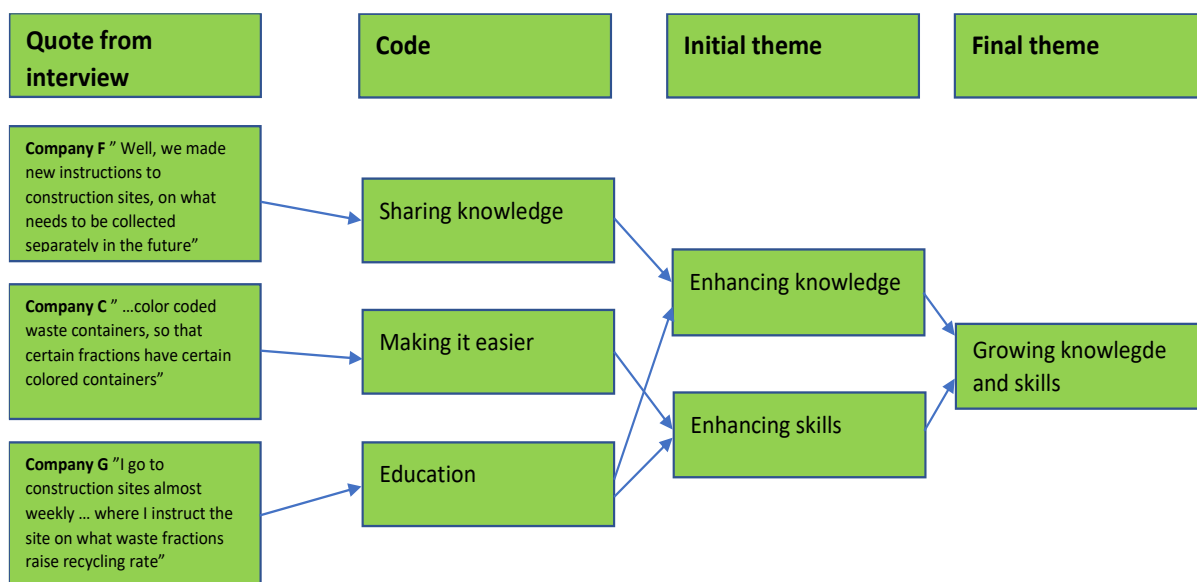


Figure 3. Illustration of coding process and theme forming.

When the refining of themes was done, finally, 21 themes were formed. The themes were then categorized in accordance with the research questions. Figure 4. illustrates how the themes were categorized.



Figure 4. Themes and categories

The themes were categorized under three categories directly derived from the research questions. A fourth category, actions related to waste hierarchy excluding recycling, was formed because issues related to the first two steps, prevention, and re-use, of the hierarchy were mentioned in several interviews, thus this seemed an important topic.

4 RESEARCH FINDINGS

In this section the research findings are presented. This section is divided into four chapters. The first chapter explains the actions taken towards improving recycling. The second chapter is about other actions taken to improve waste management that are actually in the first two steps of the waste hierarchy, which is even better than recycling, found in the third step. Followed by a chapter presenting how waste management connects to strategy and in some cases how it does not. Finally, the fourth chapter presents issues related to attitudes towards separate collection and waste management on construction sites.

4.1 Improving recycling

Construction companies are taking various actions to improve recycling and these actions are presented below. The presentation of these findings follows the seven themes under the previously shown category which was, actions taken and planned towards recycling, in chapter 3.3.

The results show that the most preferable action taken, which was mentioned in one way or another in all the interviews, is growing knowledge and skills. Essentially, this means educating construction workers to perform better in collecting different waste fractions so that they are recyclable. There are, however, different methods in instructing construction sites on these issues. These methods vary from new instructions to separate collection and waste guides, to actual site visits where the workers are educated as illustrated in these three interview quotations.

“Probably the most concrete action taken at this point is, that we have made new internal waste instructions, which describes the new legal requirements.” – Interviewee from company B

“ Well, we made new instructions to construction sites, on what needs to be collected separately in the future” – Interviewee from company F

“I go to construction sites almost weekly ... where I instruct the site on what waste fractions raise recycling rate” – Interviewee from company G

Making recycling easier was also considered for different waste fractions in a way that certain fractions have visual aids that helps workers to sort separate fractions properly. This also tackles language barriers and such obstacles. Here is a quotation from the interviews depicting visual aids.

“We have sort of tried to make it [separate collection] into a color-coded world, which is easy to understand also to foreign workers who do not speak Finnish” – Interviewee from company C

Site managers are seen crucial in taking charge of educating and informing workers on site. Constantly managing operations is important in order to reach success in recycling. Managing on site also relates to making sure that subcontractors follow the main contractors' goals, which is an important factor mentioned by a couple of interviewees, for example:

“Even if we offer the collection equipment, it still does not mean that the sorting will be successful, it still must be actively managed all the time” – Interviewee from company H

Another action mentioned by all interviewees was monitoring recycling and sorting rates. Monitoring waste management is done on many levels of the company, from site managers to company managerial level. Some companies have developed their own monitoring systems that are relatively easy to follow and encourages recycling. Other companies use reporting that is provided through waste management companies. Reporting can be done in real time which helps keep track of which way things are going and if a site is not performing towards recycling goals it can be reminded of them straight away:

“Well, we have a kind of real time monitoring, where we can for example follow sorting rates and from there I conduct reports for the company. This way we see where we are going, so quite actively is monitored.” – Interviewee from company J

In some cases, monitoring was also seen a good way to develop a certain competition between business units on who has the best recycling rate or sorting rate. The research shows that instead of actual recycling rates, most companies prefer to monitor sorting rate. This is the amount of waste fractions that are separated from mixed waste and differs from recycling rate only in the way that sorting rate is not affected whether the separately collected fraction is recycled or not. This extract from an interview explains why sorting rate is preferred.

“We ourselves look more into sorting rate. It is more precise because other operators [waste management companies] do not affect it. And from our waste nearly 70% is sorted to other fractions than mixed waste.” – Interviewee from company D

A couple of companies had also taken internal auditing as part of the monitoring process on top of reporting. This means that there are company representatives visiting construction sites and checking that everything is done as required.

Collaboration with waste management companies was seen beneficial in improving recycling, since waste management companies have good knowledge of the subject matter. Collaboration is done in planning waste management on construction sites. The waste management company's representative conducts a

waste management and sorting plan with the construction site manager. This helps the site in choosing the right containers for separately collected fractions. In some cases, the collaboration goes as far as piloting new materials for recycling. Here is a quotation explaining collaboration with waste management companies.

“With our waste management partner, we have considered other possibilities for containers, apart from the traditional demountable platform” – Interviewee from company C

Another important topic that was mentioned by a few was advance planning. Planning waste management practices before starting construction gives it more priority and helps plan the space needed for the containers and logistics needed to achieve separate collection.

The above-mentioned findings are actions taken already by construction companies. However, more detailed education and tighter monitoring was also planned for the near future. Additionally rewarding and incentives were planned to achieve even better recycling rates:

“We are creating campaign to enhance recycling and maybe occasionally we might reward best performing projects related to recycling” – Interviewee from company H

4.2 Waste prevention and re-use

Waste management includes other procedures than recycling as well and these were also recognized in the interviews. The study shows that construction companies are taking several measures to minimize waste. These measures include proper planning and designing of production procedures to ensure material efficiency. Monitoring plays an important part in material efficiency, waste minimization and constant development of procedures. Repurposing construction materials on site if usable was also discussed by the interviewees. Lastly, proper storing of materials on site plays a major role in mitigating waste.

Planning and designing procedures and the quantity of materials needed was mentioned by several companies and is seen very important, since it affects a number of things related to waste minimization. Planning means that timetables hold, and materials are delivered when they are needed, so that they do not have to be stored in the construction site. Storing on site always increases risk of containment of materials, for example rockwool getting wet. Proper planning lessens the risk of doing things in a wrong order, thus less waste is generated when no repairs are needed during construction. Some companies clearly consider waste minimizing an important factor of the construction project:

“Minimizing waste generation is the image of the whole [construction] project. It involves a lot of things. Generating less waste, a prerequisite for this, is that project plans

are done timely. This leads to that work [processes] could have been planned well. By this I mean that no one is uncertain in what is done and in what order.” – Interviewee from Company H

Material efficiency is related to planning. Material efficiency is a crucial matter in waste generation. Ordering the right quantity of materials is considered a good way to avoid excess materials becoming waste. However, there seems to be a culture to order excess to ensure that materials do not run out in the middle of a construction process:

“We have a sort of habit in the construction industry that if, for example, you need a hundred square meters of wool you order 20 [extra packages] because there is always something going to waste” – Interviewee from company C

The quantity of excess materials generated is seen as something that the construction companies can affect themselves. However, for example how much waste is generated from packaging when material is delivered to construction sites is something they cannot influence a lot. Some companies have discussed with providers about lessening the amount of packaging materials. This however includes the risk of material getting damaged during transportation because it is not so well protected. Therefore, less packaging materials might increase amount of waste if materials are damaged. The following quotation illustrates influencing material usage.

“We must always remember that we can only influence what materials are wasted and how we use them [materials]. However, with for example packaging materials, it is really difficult to influence [the amount of] them.” - Interviewee from company G

Another way of minimizing waste amount is to repurpose temporarily used materials whenever they can be repurposed. For example, a lot of wood is used for temporary constructions, and this wood can be used repeatedly on the construction site for other temporary constructions. This was mentioned by most of the companies interviewed.

Companies that re-sell excess construction materials exist, and these companies are used to minimize the number of excess materials ending up as waste. This is a good way to re-use materials because if they end up in waste containers, they are more likely recycled than re-used. These collaborations were mentioned by a few interviews and here is an example of one.

“It is a company that pick up materials from us for sale. They have a kind of hardware store where builders can the go and purchase materials for a lower price” – Interviewee from company C

4.3 Waste management's connection to strategy

The study identified two kinds of connections between waste management and company strategies, direct and indirect, and the connections are presented below. As the previous chapters this one will also follow the themes recognized from the interviews to present the results. A table to show waste management goals and connection to strategy is presented at the end of this chapter.

All but one company interviewed had internal goals for waste management. However, how waste management is connected to business strategy showed interesting and not so straight forward findings. In a few cases waste management and recycling was an important priority that was integrated in the company strategy. In other companies' waste management is not directly embedded in company strategy. However, they have other environmental goals or sustainability matters that are integrated, in which waste management and recycling plays a part. Therefore, the connection to strategy is indirect. The following interview quotations illustrate the variation of the strategical connections.

"Now we just made a new strategy and in it, it has been decided that recycling rate must exceed 70% by 2025" – Interviewee from company C

"Our organizations strategically most important goals are our climate goals and carbon mitigation. Of course, waste management supports these goals, but it is a small part of the whole and therefore, the focus is strongly elsewhere." – Interviewee from company A

Only one company did not have any direct or indirect connection with their goals and current strategy. However, sustainability will play an important part in their next strategy that is under development and through this, environmental issues will also play an important role:

"Sustainability will be there surely [in their new strategy] and then environmental issues strongly relates to sustainability and in construction industry also recycling strongly relates to environmental issues." – Interviewee from company F

Table 2. illustrates what kind of recycling and waste management goals the interviewed companies have and their connections to their strategy. As demonstrated here, there is some variation to the goals construction companies are setting internally, even though the national and EU goals are quite precise.

Table 2. Waste management goals and connection to strategy

	Waste management goals	Connection to strategy
Company A	Company has goal to recycle 70%. But the main environmental goals have to do with climate and carbon neutrality, where waste plays an important but a rather small part, so it is not a center focus	A yearly action plan of best practices in recycling is integrated in strategy. This plan is also communicated to construction sites.
Company B	Goals are derived from EU taxonomy and reporting responsibilities related to it. Waste is a part of the reporting that a public company needs to do in the future.	Sustainable development is a main goal in strategy. In the future actions will exceed the needs to fulfill any certifications.
Company C	Strategy has 70% recycling as a goal to be reached by 2025. Sorting 70% of waste has been a goal for longer.	Recycling and sorting of waste are embedded in company strategy and considered an important issue.
Company D	Goals are for sorting rate. No goal for recycling rate.	Waste management is not directly connected to strategy. But since there are other environmental goals, which waste management relates to, that way it is slightly connected.
Company E	Yearly tightening goals to recycling. Not 70% goal because this is seen impossible to achieve.	Recycling goals embedded in strategy
Company F	Goal to increase recycling yearly and minimize the amount of mixed waste.	Not connected to current strategy. New strategy is being created. Sustainability will play a strong part in it. Under sustainability environmental issues are considered, therefore, also recycling.
Company G	70% recycling rate is a goal. Goals are followed from top management to site manager levels. Primary goal to minimize amount of waste.	Waste management and its goals are embedded in strategy.
Company H	Sorting rate is a goal. Recycling is not a direct goal.	Sorting level is a strategic goal.
Company I	No internal goals. Goal is to follow the law.	Environmental standard ISO 14001 mentioned, but no other apparent connection to strategy.

Company J	Sorting level goals. This year a goal for each business unit to have a construction site that sorts everything, so no mixed waste is generated.	Sustainability is part of strategy and waste management through sustainability. Efficient production is a strategical goal, and this is connected to waste minimization.
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4.4 Attitudes towards recycling and separate collection

The attitudinal issues that were found in the study are presented in this chapter. Some of the attitudinal problems were also seen as real problems by some interviewees. This is also considered and mentioned in the chapter below.

The most mentioned attitudinal issue was limited space on construction sites and the logistics related to it. This refers to not being able to fit all the needed waste containers to the construction site and the problems arising from emptying the containers in tight spaces. This is also seen as a real problem in some cases. However, it still leans towards being more of an attitude problem. Instead of finding solutions to fit containers to the site it is seen easy to explain low recycling rate with limited space. These difficulties are also considered lack of knowledge for optional solutions. The following extracts from the interviews demonstrate how limited space is seen as more of an attitudinal issue.

“In some cases, one can think it [separate collection] takes u a lot of space, but this is more of an excuse than a real problem in my opinion, so we come back to attitudes again.” – Interviewee from company A

“My experience is that construction sites where there is a shortage of space are usually much more ready to think of slightly more creative solutions for their waste management, compared to the sites where there is as much space as a football field around and they can fit 35 containers there. In a way, the number of containers does not solve the question of how well recycling is taken care of, if the attitude is not right.” - Interviewee from company G

The EU set goal of recycling 70% as materials raised controversial reactions in this study. Some thought it to be easy and some achievable with proper actions. However, a few considered it to be unachievable with current recycling possibilities and suggested that it cannot be reached by separate collection on site. One interviewee even went so far to suggest that the only way to achieve a 70% recycling rate is to do it in a waste management plant, not on site. The controversy of reactions is depicted in the following quotations.

"70% is easy in my opinion, it doesn't require any magic tricks" – Interviewee from company G

"70% [recycling rate] is an undoable thing. Unless sorting plants can be accepted to do it. But that is the plants recycling rate then [not the construction company's]" – Interviewee from company E

Cost of recycling is also seen as a problem by some companies. That it is more costly to recycle waste materials compared to burn them for energy. This is again a controversial attitude, because to some companies it was self-evident that recycling is less costly. This is because there is less cost in processing recyclable materials than mixed waste. Some materials are even worth something for the construction company, such as metals or some plastics. Cost of recycling wood was also pointed out by a few companies, because as of yet there is no option to recycle wood in Finland and it must be transported abroad. The following extracts illustrate the controversial attitudes in cost of recycling.

"Here [in Finland] there are certain practical problems with achieving recycling goals. We can of course recycle everything, if we are paid enough, that is not a problem, however, at the moment recycling everything is not economically viable. – Interviewee from company E

"The biggest motivation [for separate collection] is that it is cheaper if you actually sort and recycle. If mixed waste costs for example 150 euros per ton and 70%, actually 80% of the materials in it are recyclable and you take them separately and you are paid for metals and plastic." – Interviewee from company C

Transport costs were also seen as an issue for recyclable materials. Usually there is less distance to transport mixed waste, or energy waste. Whereas recycling of certain materials can only be done in some places, in some cases it has to be transported abroad. In collecting small amounts of waste, it was mentioned that the transport would obviate the benefits achieved from material recycling:

"We have a lot of waste fractions and if for example there is a construction site in Rovaniemi that generates 70 kilograms of gypsum waste, is it really worth it to drive it all the way to Lohja" – Interviewee from company E

It was also mentioned that the law is too strict and therefore causes difficulties. However, Finnish people are considered to be law abiding citizens, so the attitudes are seen as changing, at least in some cases:

"[law of separate collection] This is considered extremely challenging on some construction sites, partly even unconscionable." – Interviewee from company E

"I believe us Finns, on average, to be law abiding citizen, so it [law of separate collection] will sink into us eventually." – Interviewee from company I

The overall attitude to recycling and separate collection is quite good. The general opinion was mostly that nowadays there is not so much need to explain why recycling and waste management is important. However, sometimes it was evident that the company sees waste management as a low priority and in order to achieve better results it should be prioritized higher:

"With challenges for example in material availability, prioritizing has been unfavorable to waste management" – Interviewee from company A

"I hope that we will get a better grasp of it [waste management], because this [low priority] is concerning in my opinion" – Interviewee from company A

5 DISCUSSION

The aim of this Master's Thesis was to find out what kind of actions construction companies are taking to better their waste management and how these actions are connected to company strategy. In addition, attitudes towards recycling and separate collection of waste fractions were studied. This section discusses the results presented in the previous chapter in relation with the aim of this Master's Thesis. The results are also compared with the theoretical framework presented in chapter 2. The discussion starts with actions to improve waste management, followed by strategical connections and attitudes and ending with an additional chapter compiling the findings together and proposing how strategy, actions and attitudes relate to each other.

5.1 Actions improving waste management

This study identified actions to improve waste management from the three first steps of the waste hierarchy. The results are discussed in relation to the waste hierarchy, regulations and previous research presented in chapter 2.

The findings show that various actions are taken in the management level to improve knowledge and skills of what and how to collect separately to improve recycling. It was interesting and important that each company interviewed pointed out that educating and growing skills are among the most important actions towards improving waste management. Liu et al., (2019) also point out that improving knowledge and education in waste management practices is seen important in order to improve it. The findings of this study correlates completely with Liu et al, (2019) statement. Education and growing skills are also important findings considering the law of separate collection. The new regulations need education as stated by (Levinen, 2021). The fact that the interviewed companies are acting now that legislation requires them to do so also supports Diemer et al., (2022) stating that reaching circularity in the construction sector is highly dependent of legislation and private companies own actions. Actions to enhance separate collection also coincides with previous research that state the importance of separate collection in order to keep materials recyclable and lowering the impact on environment (e.g., Zhang et al., 2022; Dahlbo et al., 2015).

Collecting wastes separately potentially helps companies to reach a higher recycling rate (Liikanen et al., 2019). And get closer to achieving the 70% target set by Finland and the EU (Levinen, 2021). Separate collection also supports less materials ending up in landfills and keeps more materials in circulation (Teriö et al., 2014). The results of this study suggest that companies are invested in improving separate collection, which hopefully will bring Finnish construction companies closer to the EU recycling target. Liikanen et al., (2019) point out that

additional measures need to be taken to reach the 70% target. The findings of this study show that a lot is done from planning to education and auditing. However, whether the measures found out in this study are enough to reach the recycling target remains to be seen.

An interesting finding was the way some construction companies monitor their waste management. Even when, according to Levinen (2021) the national target of Finland is to recycle 70% of construction waste the construction companies prefer to monitor sorting rate rather than recycling rate. Sorting rate monitoring was a novel discovery that is not mentioned in the literature reviewed for this Master's Thesis. This is seen as a good way to monitor waste management because the construction companies cannot always affect what happens to waste when it is picked up from the site. This way the company can monitor that different waste fractions are collected in a way that they could be recycled if recycling is an option. The legislation also supports this option, whereas it requires companies to arrange separate collection for waste fractions but does not require the fractions to be recycled (Levinen, 2021). However, this leaves the question of who is responsible of following the recycling rate if the national goal is to recycle. This also leaves a concern that if the sorting rate is followed and the companies are reaching their goals in it, but recycling rate remains low, who is responsible? Should the waste management companies be obligated to recycle separately collected wastes if the material is recyclable?

Teriö et al., (2014) claimed that the reason for environmental action taken by construction companies is often based on meeting customer demands and pressure from the public. The results in this study did not show this relation but rather that the goals and actions were taken to improve recycling and waste management in general. However, this might be the result of the new waste act giving incentive to enhance waste management.

Collaboration between construction companies and waste management providers is a mutually beneficial way to improve recycling of materials. This is important in order to develop new ideas on how to recycle and how to manage different waste streams. Previous studies also suggest that developing new waste management procedures are needed to reach the targets set by EU (e.g., Tomić & Schneider, 2020).

According to the waste hierarchy prevention of waste and re-use of materials as such are more preferable than recycling (European Commission, n.d.). The research shows that construction companies are taking actions to follow the steps of the hierarchy. Zhang et al., (2022) propose that waste prevention is the most important principle of the waste hierarchy. The results of this study show that construction companies give importance to planning procedures that take material efficiency into consideration. Companies realize that proper planning is an important way to influence the amount of waste generated. Planning and measuring procedures will likely have a positive effect on the wasteful cultures of ordering excess materials mentioned in the results.

Re-using materials in the construction site before discarding them as waste was also seen an effective way to lessen the amount of waste generated. This

raises a question that if there are temporarily used materials that can be re-used on one site, could they be moved also to another site rather than discarding them when the construction is finished. This way the next site would not have to procure such materials themselves and therefore, would generate less waste. The actions taken in preventing waste and re-using materials are also in line with the new waste act stating, according to Levenen, (2021), that companies must take measures to follow the waste hierarchy in preventing the amount of waste.

5.2 Strategic connections and attitudes

The results show that strategical connections varied from company to company and below there is discussion of why waste management strategies being embedded in the overall company strategy is important and how these connections affect the overall performance in waste management. Attitudinal factors identified in this study are also discussed with a comparative table showing changes and similarities in attitudes compared to previous findings.

Solovida and Latan (2017) propose that environmental performance is positively affected by having a proper environmental strategy. The necessity of embedding environmental issues to company strategy is pointed out by other researchers as well (e.g. Baumgartner & Ratner, 2017). The results of this Master's Thesis show that all, except for one company studied have waste management somehow related to their company strategy. However, five companies have the actual goals for waste management embedded in their strategy and the for the rest waste management connects through other sustainability goals. Considering that 35% of all waste in the EU comes from the construction industry (Villoria Saéz & Osmani, 2019), it could be stated that having better strategies for waste management would improve the entire industry sector and therefore there are definite improvement possibilities in strategic planning.

Constant improvements, for example yearly action plans, on a strategic level were mentioned by three companies and this agrees with Solovida and Latan (2017) presenting that the process of constant advancements in environmental actions needs improvements in the awareness, knowledge, and expertise of employees as well as commitment from managers. This finding suggests that the companies investing in constant improvement will likely succeed in reaching their goals in the future.

The results show that there is management level investment in waste management and therefore, there is a chance in developing proper waste management strategies that go beyond compliance for the company. Solovida and Latan (2017) argue that management involvement with environmental issues directly affects the company's capability to develop environmental strategies going beyond compliance. However, even when the capability exists none of the companies interviewed in this research mentioned current goals that would exceed compliance of the Finnish national goal of recycling. Company B pointed that

their actions would fulfill the needs of any certifications in the future, and this can be understood that they are planning to go beyond compliance in the future. One possible reason for not developing goals that are beyond compliance might be that the recycling rate haven't even reached compliance yet.

Two of the three companies that had their waste management goals directly integrated in their strategy had a goal to recycle 70% of their waste. These goals were also monitored from top management to site level, so in principle throughout the company. These companies are likely to succeed in their goals because previous research argues that good environmental strategy results in good performance, the implementation of the strategy also has an apparent effect in the company's environmental performance (Solovida & Latan, 2017). The fact that the set goals are monitored top down suggests that the strategy is implemented properly from top down also.

Table 3. shows the similarities and inconsistencies comparing the results of this study with the attitudes, subjective norms and perceived behavioral control found in the expanded theory of planned behavior by Teo and Loosemore (2001). The similarities are on a white background and the inconsistencies are painted gray for the benefit of pointing them out more easily and if only the right side of the table is painted gray, it means that results are partly controversial. Under the table there is more discussion on the topics. The similarities are discussed shortly, but the main focus is on the differences.

Table 3. Comparing results to expanded theory of planned behavior

Teo & Loosemore (2001)	Result of this study
Attitudes	Attitudes
Few incentives	Partly similar results, however incentives are planned by some companies.
Skepticism of waste reduction	Controversial, because a lot is done to reduce waste amounts.
Poor knowledge of residual values, consequences of waste, ways to reduce waste & responsibilities	Similar attitudes are partly found in this study. For example, belief of recycling being costly. Results on the contrary found as well
Belief that waste is inevitable	Did not come up in this study
Subjective norms	Subjective norms
Pragmatic and wasteful culture	Similar results found
Sense of unfairness	Law considered too strict is a sense of unfairness
Inconsistent industry standards	Different goals and ways to measure waste management could be seen as inconsistent industry standards
Waste a low priority	Similar results found

Low management commitments	Controversial to this study which found management committed and overall attitude seems positive.
Unclear / absent policies	Controversial to this study, a lot of guides and policies made. Also, law is clear on what is needed to be done.
Poor consultation	Did not come up in this study
Perceived Behavioral Control	Perceived Behavioral Control
Time pressure	Did not come up in this study
Cost pressure	Similar results for cost of recycling
Poorly designed work processes	Limited space could be because of poorly designed work processes
Lack of markets for waste	Partly true in recycling wood for example
Waste reduction is inconvenient, impractical, and costly	Limited space and 70% recycling being unachievable could be seen as an inconveniences and impracticalities as well.

Some of the previous topics were not found at all in this study for example time pressure issues or poor consultation. A lot of similarities were found that are like Teo and Loosemore's (2001) findings, which is concerning since the previous study is over twenty years old and construction companies are still struggling with the same issues. For example, the issue of seeing waste as a low priority in some interviews, even when managers are somewhat committed to environmental issues and waste management raises concerns on how to change this attitude. Low priority, however, was not the case in all the interviews which might suggest that this will change in the future because of better management commitment.

The results are showing that even now, there are few incentives. however, incentives are planned in some companies, which might lead to others adapt incentives as well. Another similarity that is interesting is the lack of industry standards. Even with Finland and the EU striving for the same goals, construction companies are yet to adapt these in unity. However, even with lacking in industry standards, skepticism towards waste reduction does not seem to exist anymore according to the findings of this research. All the companies studied are taking measures to reduce waste generation and therefore, it can be stated that they belief that waste can be reduced.

The value of waste materials is known to some companies interviewed, while others did not see value in waste and thus considered recycling to be costly. These controversies can be explained with lack of knowledge. Apparently, some interviewees do not know that some wastes are actually worth something. This controversy suggests that more education on the value of wastes as well as the positive effects of recycling would be beneficial to the construction sector.

Another controversy to the previous study is found in management commitment. The overall commitment to waste management in this study was good and definite improvement can be seen here. Management commitment is advantageous for the whole industry sector, because it drives improvements and helps develop better strategies. However, this data might emphasize management's commitment towards environmental issues, since all the managers interviewed were responsible of environmental management and waste management in their companies. On the other hand, the fact that all the companies had management level positions responsible of these issues suggests that the overall management is committed, since these positions have been created.

All the companies studied had developed instructions and guides on waste management on their construction sites. This is controversial to the findings of unclear or absent policies by Teo and Loosemore (2001). The fact that policies are developed and implemented is driving waste management practices further in the construction industry.

Recycled wood was the only material that was seen as not having a market in Finland, only abroad. Other materials were not seen as lacking markets. This leads to the conclusion that recycling has developed a lot since Teo and Loosemore (2001) conducted their research and the lack of markets for waste have probably diminished due to developments in recycling.

5.3 Action, attitudes, and strategy

This chapter proposes how strategy, actions and attitudes affect one another. The results of this study and previous research strongly indicate that there is a relationship between the three. The relationships are explained below through previous research and results of this study, with an additional figure (Figure 5.) demonstrating these relationships.

The results and previous research (e.g. Solovida & Latan, 2017) suggests that management commitment affects how and what kind strategies are developed in a company. The more committed the management is the more likely the topics will end up in company strategy. As discussed in chapter 5.2. proper environmental strategies affect directly to performance and therefore, strategies also affect actions taken by the company. The results of this study show that if a company has waste management goals integrated in their strategy, it will directly affect actions as well.

Teo & Loosemore (2001) and Begum et al., (2009) argue that attitudes towards construction waste management are positive if workers have experienced successful waste management previously. This leads to the argument that, actions affect attitudes. These above-mentioned relationships are pointed out with the clockwise arrows as seen in Figure 5.

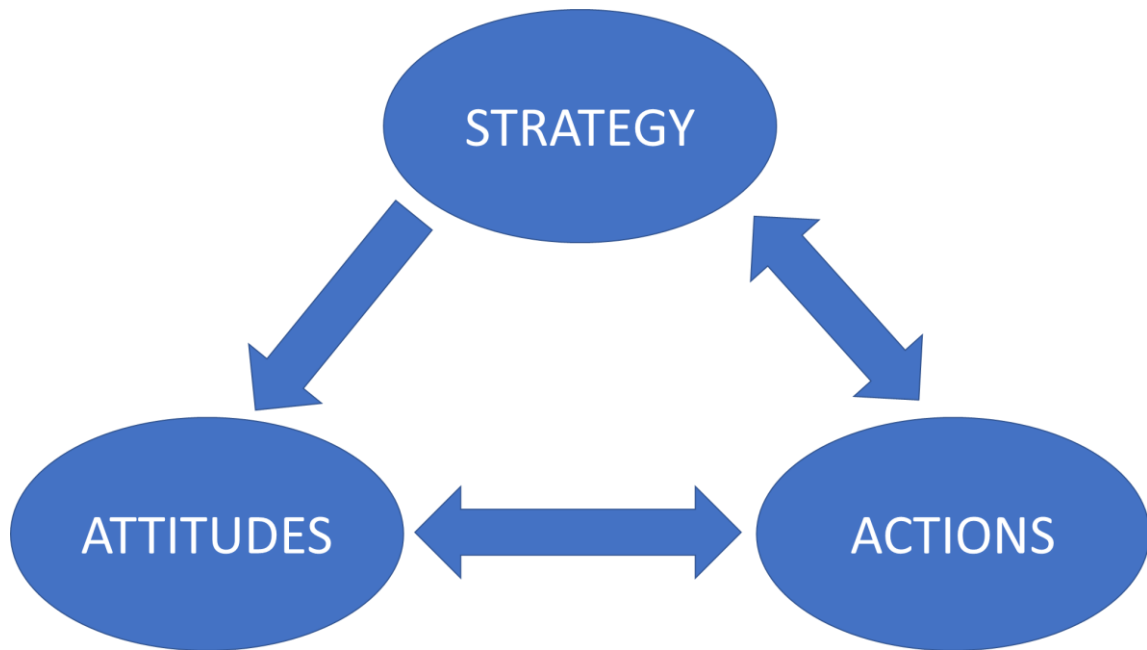


Figure 5. Relationships between strategy, actions, and attitudes.

The counterclockwise arrows show relationships the other way around. As Teo and Loosemore (2001) argue that workers will not put much effort unless management is committed towards these issues, and how management commitment is related to strategy development, it can be argued that strategy also affects attitudes. Olson and Zanna, (1993) argue that attitudes affect how people behave, which supports the argument that attitudes also affect actions. The results of this study also supports this. For example, with limited space, which was seen as an attitudinal issue, workers are more likely to create new solutions or actions for recycling. The fact that actions affect strategy is self-explanatory, if wrong action is taken the strategy will likely fail and if the right action is taken strategy is more likely to succeed.

With the relationships between strategy, actions, and attitudes showing so distinctively, this study suggest that companies should consider all three together when making decisions and plans on either one, because changing one part most likely affects the other.

5.4 Limitations and future research

This study comes with limitations. Firstly, the sample size is not adequate enough to give a comprehensive picture of the whole construction industry in Finland. In order to get a more comprehensive picture, small and medium sized companies should also be studied, as well as renovation and demolition companies. If considering only large construction companies in Finland the sample size could

be seen to be sufficient because it was around half of all large operators. Country specificity can be seen as a limitation as well

Another factor affecting this study is the timing of the research on the exact time of enforcing new legal action. Had these questions been asked a few years ago the results would likely have been different. They would probably also be different a few years in the future.

The interviewees were people from middle management who are responsible for environmental issues within the company. This might have distorted the managerial commitment to environmental issues because the interviewees work is strongly related to these issues. In order to limit this distortion, other management level representatives should be interviewed as well.

Finally, the lack of the authors experience as a researcher has likely affected the way the data was analyzed, and the results presented. The scope of discussion is also affected by lack of experience in conducting research.

This study raises opportunities for future research. In this study actions that are currently taken to improve recycling and waste management were recognized. However, it did not measure the actual performance of construction companies. This could be studied by comparing the actual recycling rates from the past with current and future rates to see if there is actual positive effect with the actions identified in this study.

Separate collection of waste fractions on construction sites improves the possibilities for the materials to be recycled or re-used. The value chain of these materials could be researched further by studying what actually happens to the materials when they leave the construction site. This study could include studying waste management operators and industries that use recycled materials.

The relationship between strategy, actions, and attitudes, proposed in chapter 5.5. is an interesting finding that should be studied further with a larger sample size. It could also be studied in different industry sectors because the author believes this relationship is not limited to the construction industry.

6 CONCLUSIONS

In this final section the significance of the results is explained. This Master's Thesis intended to answer the questions of what actions construction companies are taking to improve waste management and how these actions relate to their company strategies. It also aimed to see what sort of attitudes exist towards waste management and separate collection of different waste fractions.

The results indicate that actions are taken, of which increasing knowledge and educating workers was the most preferred action to ensure proper waste management and separate collection on construction sites. The significance of the actions taken are directly related to meeting the obligations of the new regulations in the Finnish waste act. Whether the actions presented in this study really improves recycling and waste management need to be studied further. The results also showed direct and indirect connections to company strategy. However, there seems to be room for improvement on this part, which is contributing the construction sector to consider including waste management more in their strategies, because as previous research suggests that better performance can be achieved through strategy.

As for the attitudes, they seem to have improved compared to previous studies. Especially management involvement was strong in the results. Management involvement is seen crucial to the success in taking more action to mitigating the environmental impacts of construction. The results also indicated that construction companies believe in lowering the amount of waste more than before. The proposed relationship between strategy, actions, and attitude needs further investigation, but also gives motivation for companies to consider each aspect when making decisions in any.

This overall study presented above helps construction companies understand the current state of actions, strategies and attitudes towards waste management in Finnish construction industry and should entice construction companies to further develop their strategies, because a lot of work still needs to be done to reach the national goal of recycling 70% of construction waste in Finland.

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