Master's degree thesis

LOG950 Logistics

Does waste really mean waste?

An initiative to justify waste as a valuable object in the reverse logistics processes at Vestbase AS

Razib Ahmed

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Molde, 28.02. 2014

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Acknowledgements

June 2013, I met Associate Professor Per Engelseth, in the university college canteen. I asked him straight out if he was interested in being my supervisor for research into a Master Thesis. This was the first time I met him. To this day, I admire Associate Professor Per's courage to say yes to a stranger and put his trust in me. My greatest appreciation is expressed for his scientific supervision, for our productive discussions, and for his being so demanding all the time, because it challenged me and pressed me forward.

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Most of all, my loving thank to my dearest parents, brother and sister-in-law for your love and patience. I could never explain how much I missed my family during these years and how much their love and spontaneous support meant to me. What helped me to go through during these years were the teachings I brought from home: the values, vigor and integrity.

28. 02. 2014

Razib Ahmed

Preface

Imagine, a 13 years old teen preparing to go to school, being quite hesitant of leaving his house. It had been raining cats and dogs last 2 days, as a result all the streets and playgrounds in the suburbs looked like a waste landfilling yard. The air was contaminated and it did not feel fresh to inhale. He always used to think "why don't people throw waste in a particular place?" This was me as a teen, not yet knowing that waste carries a hidden value, that there is a certain concept about this.

Although the waste management system has improved since then, the concept of hidden value within is still capturing my interest. Consequently, I wanted to use the opportunity to assess the value creation in waste management in relation with logistics. To my friends, home and abroad, it was a laughable topic and does not really sound like something one should be proud of.

Once commencing my thesis, I carried conversational interviews with friends and family, and with middle sized supply chain company managers. Neither the low level of awareness about the topic, nor contradictory opinions have discouraged me to pursue this research. This exploratory study will hopefully raise awareness and consciousness about this topic, giving some guidelines about waste prevention, waste handling and value of waste in relation to logistics.

As a first step, I encouraged my close friends to rather reconsider the value of any item that is about to be disposed, given that this project focuses on reverse logistics, waste management and value creation. In our lovely blue planet, 130 million tons of municipal solid wastes are combusted annually. These wastes are transformed in over 600 wastes to energy recovery facilities that produce electricity and/or steam for district heating. I can see value in waste in relation with logistics and/or anything, simply because it is everywhere and it has value.

Abstract

Purpose – This study is an independent project conducted on Vestbase AS. The main focus of the thesis is on the analysis of the value creation from Vestbase's waste management process in a network. The purpose of this project is to identify how value is created from waste management, detecting challenges and barriers, and providing possible suggestions to increase value creation from waste management along with reverse logistics.

Design/methodology/approach – This study is a qualitative study and the design follows an exploratory case study. The research questions are linked to each other, meaning that solving the first research question, gives the presumption to solve the next and so forth, in accordance with the exploratory research design. Literature review, with respect to waste management, ownership and value creation theories, guide this study towards new definition of waste, waste management and value creation model from waste management in a customer value perspective. Data used in this study were collected, through interviews and observation, and analyzed on the basis of building theory from case study.

Findings – The empirical findings shows that value is created from waste management process. All the parties in the waste management process contribute in the value network, when they become the owner of the waste. From the contribution in the value network, each party receives financial and non-financial benefits. However, there are challenges and barriers detected in the value creation process. To overcome the challenges and barriers a new model is proposed which may help to increase value creation.

Research limitations/implications – This study deals with a single industry analysis and hence its findings cannot be generalized to other industries. The proposed solutions are suggested based on the exploratory case study basis, which has no concrete method of justification. This means that the findings are not justified by measurable unit.

Originality/value – This study is somewhat different from the accepted and traditional belief or practice of waste management. This study offers an invitation to dialogue and to follow the author's perspective of viewing waste from a different standpoint, which is considered as a "valuable object". The study contributes to more knowledge on the nature of value creation in waste management network.

Keywords: definitions, ownership, theory, waste, waste management, logistics, reverse logistics, value, value creation.

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Nomenclature

Abbreviation	Explanation
ADEME	Agency de l'Environnement et de la Maîtrise de l'Energie (French Environment and Energy Management Agency)
ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road
BAT	Best Available Techniques
BEP	Best Environmental Practices
CEWEP	Confederation of European Waste-to-Energy Plants
CLM	The Council of Logistics Management
CSCMP	The Council of Supply Chain Management Professionals
EC	European Commission
EC	European Communities
EC	European Council
EE	Electrical and Electronic
EEA	European Environmental Agency
EPA	Environmental Protection Agency
ERP	Enterprise Resource Planning
FEVE	The European Container Glass Federation
FOEEurope	Friends of the Earth Europe
GHG	Green House Gas
GT	Gross Tonnage
HVLP	High Volume Low Pressure
IAI	International Aluminum Institute
IMO	International Maritime Organization
LRW	Low Radioactive Waste
LVLP	Low Volume Low Pressure
MTTF	Mean Time to Failure
MSW	Municipal Solid Waste
OECD	Organisation for Economic Co-operation and Development
PVC	Polyvinyl Chloride
RL	Reverse Logistics
ROA	Return on Asset
ROI	Return on Investment
SCM	Supply Chain Management
SSB	Statistics Sentralbyrå (Statistics Norway)
UN	United Nations
UV	Ultra Violet
VBO	Vestbase AS Base Operation
WAMED	Waste Management Efficient Decision
WEEE	Waste Electrical and Electric Equipment
WM	Waste Management
WRAP	Waste and Resources Action Program

1.0 Chapter One: Introduction

1.1 General background

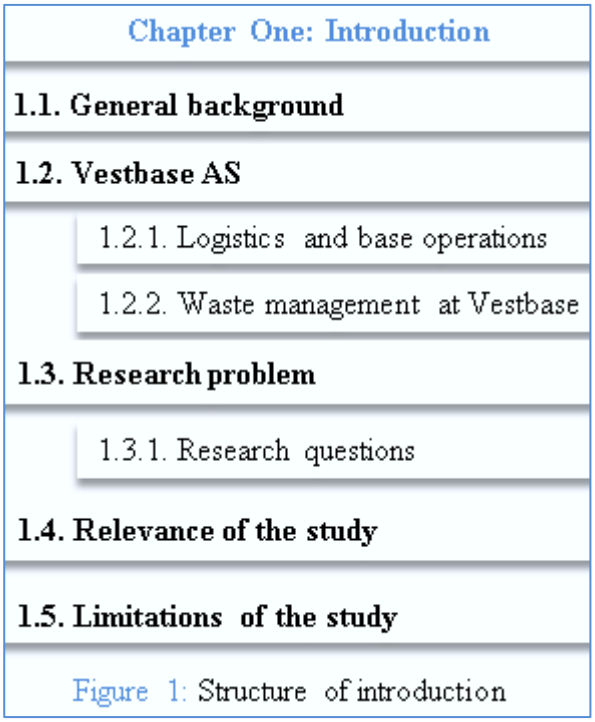


Figure 1: Structure of introduction

Considering the social, environmental and financial effects of waste, the author became interested in value creation from waste management (WM), its challenges, opportunities, vast range of influencing factors and the consequence of multi disciplinarily of the field. All things considered, waste management involves reverse logistics (RL) activity, management procedures, economic and legal factors, and environmental and social implications. What does waste actually mean and how it generates value through the reverse supply chain process, are considered for this study.

A number of scientific publications admit the value of waste and offers numerous definitions and guidelines for waste management (The European Council, 1991; Gourlay, 1992; Kirkpatrick, 1992; Ellwood and Patashik, 1993; Woodruff et al., 1993; Lox, 1994; Cheyne and Purdue, 1995; Rutner and Langley, 2000; Pongcraz, 2002; Pongcraz and Phjola, 2004; Mollenkopf and Closs, 2005; Rogers and Tibben-Lembke, 2009; and Muir, 2010).

On the other hand, some other publications only focus on environmental impacts of waste management, giving a vision that waste management is only needed as a safeguard mechanism of environmental protection (McKinney's, 1986; Thomson, 1995; Stock et al., 2002; De Brito and Dekker, 2003; Wang et al., 2008; Moutavtchi et al., 2010; and Eugene et at., 2011).

However, most of these waste management publications barely defined ‘waste’ that can describe waste in respect of time and transformation (Pongcraz, 2002 & Pongcraz and Phjola, 2004). Similarly, a large number of scientific publications report that what is waste to someone might not be considered as waste to others (Gourlay, 1992; Pongcraz, 2002; and Pongcraz and Phjola, 2004). General populations consider garbage as waste but the same waste is considered something valuable to the waste management company. Therefore, there is a need to re-define waste and waste management in respect with value creation that can satisfy all.

Viewed from such perspectives, it is reasonable that the author tries to choose an empirical research through exploratory case study. The main approach applied in this study is theory building from case. Campbell (1957) defined theory as the state of contemplation, which is different from the state of action. Therefore, any theory describes what can be experienced in real life. Similarly, this study is conducted based on the analysis of a real world phenomenon, which is the waste management of Vestbase AS. One of the main interests is why and when is something called waste. Therefore, the first aim is to provide a clear definition of waste.

Similarly, this study is somewhat different from the accepted and traditional belief or practice of waste management. On a daily basis, general populations deal with garbage, this is often considered as waste. The safe disposition of these wastes is called waste management. However, waste management is not only about garbage collection and disposition, but also focuses on minimization of waste production and re-capturing value by re-using, re-selling, recycling, energy recovery and final disposition. Therefore, this study re-defines waste management pointed out solutions to individual waste problems.

Moreover, this study attempts to integrate reverse logistics into waste management in the theoretical perspectives. Rogers & Tibben-Lembke (2002) argued that the development of reverse logistics is in the beginning phase, which only emerged within the last one decade or two. Thus, the integration of reverse logistics into waste management is a new area of research. Therefore, how the reverse logistics along with the waste management process create value for the actors involve in the waste management, is another important purpose of this research.

Furthermore, studying waste, waste management and reverse logistics, the value creation network in waste management process is developed. The aspects of value are simplified by monetary and non-monetary values where different parties take part in the waste management process and create value. Hammervoll (2009) discussed that firms rarely create value in isolation. Thus, it is evident that firms involved in the waste management process create more value than one single firm could do. Therefore, how firm create value in a network of organizations is one more important determination of this study.

In addition, Christopher (2011) argued that the final purpose of any logistics process is to satisfy its customers. Similarly, the purpose of logistics process in waste management is to satisfy its customer through the exchange process of money, wastes and information. Engelseth and Hammervoll (2013) discussed that the exchange process is concerned with transfer of title of product, service or information. Christopher (2011) describes that in the exchange process money and product or service flows in opposite direction. However, in waste supply chain this trend is just opposite between the waste producer and waste processor. In waste supply chain the money and waste (which is considered as the raw materials for further production) flows in the similar direction, which is contradictory with the traditional exchange process. Similarly, the clear indication of who the customer is in the waste supply chain is hardly mentioned in the previous scientific publications. Therefore, there is an innovative contribution in this paper to clearly define and describe the customer, its role and the added value from the waste supply chain process.

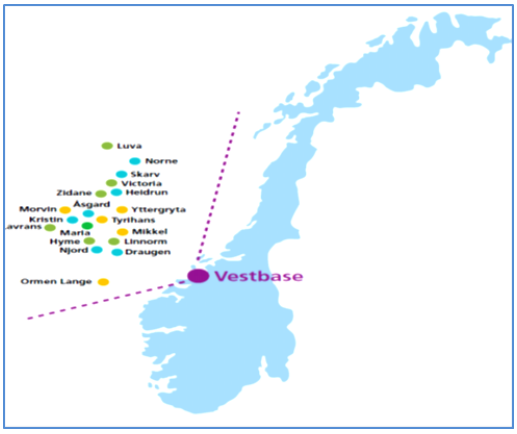
This thesis looks for solutions based on answering research questions that the way it describes the prescribing action upon it. The integral principal argument is that waste management is not only the art of how to treat waste. This treatment process is one of the important attributes of waste management and the utmost respect is apprehended by the author to those who are excelling in it. However, the author would like to see waste management as a resource management process in the reverse supply chain of waste materials, where the waste materials are used in further production process. Therefore, in this system the waste flow is considered as the cyclical material flows, rather than the last step of a material transformation line that starts from natural resource, ends up with waste and returns to earth.

The researcher acknowledges that this research might not solve all the problems of waste management addressed in this paper, but every little step forward could be appreciated. Therefore, the determination of this study is to complement the previous researches conducted by many waste management scientists. At the same time, this study offers an invitation to dialogue and to follow the author's perspective of viewing waste from a different standpoint, which is considered as a "valuable object".

This paper is divided into six chapters. Author's perception of value creation from waste management is presented as it is being exercised in chapter 1. Chapter 2 represents the literature review, giving an overview of the concept of waste, waste management, ownership role in waste management, relation of waste management with reverse logistics and how it creates value in the waste management network. Chapter 3 focuses on research methodology, data collection and explain how new waste management theory is built based on the empirical investigation. Chapter 4 represents the empirical data description along with the brief description of the focal firms and their contribution in waste management process. The analysis and discussion is carried out in chapter 5 where new definition of waste, waste management and proposed value creation model are presented. Finally, chapter 6 presents the conclusion and recommendations to the company along with the brief repetition of the limitations of the study and proposes further research.

1.2 Vestbase AS

Vestbase AS Kristiansund is one of the ten supply bases and namely the biggest of NorSea Group. NorSea Group is the leading supplier of integrated logistics system and base services to the Norwegian oil and gas industry. The supply base is located at a harbor in Kristiansund in the middle of the Norwegian continental shelf. The strategic location makes Vestbase one of the important strategic hubs for activities related to the petroleum industry.



Picture 1: Location map of Vestbase in the middle of the Norwegian continental shelf (Vestbase, 2013a).

Currently, Vestbase is the largest industrial park in petroleum industry in mid-Norway. More than 60 companies established on the base and around additional 30 located outside the base. The supply base manages and carries out specialized logistics operations in three main departments; these are the Logistics and Base Operations Department, Technical Department and Property Department.

Vestbase's property related services include rental, construction and real estate facilities. In technical side it has project logistics or heavy lift, rig maintenance, technical services, bulk/bunkers, fiber/wire rope and chain, course and training etc. For logistical operations it has terminal operations/warehousing, logistics and base operations and rental personnel etc. The main focus for this paper is concerned WM, which underlying to the unit of Logistics and Base Operations Department which are the base operations and terminal operations.

Picture 2: Vestbase Kristiansund AS (Vestbase, 2013a).

1.2.1 Logistics and base operations (VBO)

The Logistics and base operations referred as VBO, which consists of personnel and equipment of Vestbase. The VBO maintains physical movements of goods internally at the base area. It includes moving cargo in the base area including loading and unloading cargo from the ships and vessels. There are handling of crane and lifts; drill pipe and casing; and special transport. In addition, there are waste unloading, handling and transport to the WM company. The foreman is responsible for executing tasks and activities related to loading, unloading and operations of equipment at the base.

Picture 3: Logistics and base operation (NorSea Group, 2013a).

1.2.2 Waste management at Vestbase

This section provides a brief summary of WM at Vestbase. The details of Vestbase's WM are explained in chapter 4. Vestbase has both offshore and onshore waste producers. The onshore waste producers are companies located on the base. The offshore based waste producers are oil producers namely Statoil and Shell etc. The oil producers for instance Statoil and Shell have their administrative offices inside and outside the base and at the same time operating oil platforms/oil rigs in the middle of the ocean.

The offshore wastes producers ship wastes to the base for handling and further processing. Vestbase receives the wastes from the offshore waste producers and forward to companies like Norsk Gjenvinning (NG) and Maritime Waste Management (MWM). Similarly, WM companies collect wastes from the onshore companies established on the base. The WM companies then, after collecting and proper sorting, transport to the downstream parties for further treatment, for instance, energy recovery, reuse, and landfill. The process is shown in the following figure:

Figure 2: Waste management by Norsk Gjenvinning at Vestbase (Vestbase, 2013a).

1.3 Research problem

This section outlines and presents the research problem of this study. Initially, it describes the background for the project, followed by an explanation of the research problem. Later, it narrows down the research problem into the formulation of research questions.

This study is an independent research project agreed between the researcher and Vestbase AS, Kristiansund. The agreement between the researcher and Vestbase AS is mediated by Molde University College in 2013. It is a long aimed objective of the researcher to contribute in this area of research particularly value creation from waste. Since its recent development in literature the author became interested in waste management, its influencing factors and barriers to value creation along with reverse logistics.

Moreover, in real world, because of low level of awareness, waste is considered useless. Similarly, theoretically, numerous researchers define waste as valueless and waste management is the management of this valueless object to get rid of. According to Brito and Dekker (2003), waste management principally pertains with efficient and effective collection of waste, that is, commodities which have no longer any reuse possibilities. However, others define waste as a valuable object. Thus, the author wants to explore, Does waste really mean waste?

Hence, in June 2013 the author submitted a formal proposal to the logistics manager of Vestbase AS. The research interest was defined as, "Does waste really mean waste? An initiative to justify waste as a valuable object in the reverse logistics process". The proposal was accepted by the logistics manager and called upon an interview for further discussion regarding the logistics and waste management system at Vestbase. In August

2013, the interview was held among the author, author's supervisor, logistics manager of Vestbase and waste coordinator of Norsk Gjenvinning. The outcome of the interview was that there are substantial financial and environmental impacts of waste management on oil as well as other sectors of business in Norway and certainly there are areas of improvement. Therefore, the research problem of this paper explores areas in relation to Vestbase's waste, where value is created and the areas of improvement, where further value can be created.

1.3.1 Research questions

To solve a research problem it is important to define interesting research questions that should be answered through empirical investigation. According to Yin (2009), the process of defining the research questions is probably the most important step to be taken in a research study.

In this study the researcher wants to identify and analyze how value is created from Vestbase's waste management, its management network and find areas of improvement where further value can be created. During the initial observations it is exposed that Vestbase's waste management has some challenges and barriers. These challenges and barriers are related to the current waste management process and reverse logistics strategy. Therefore, these objective elements can be summed up into four research questions, which are sequentially dependent on each other. They are

- What are the types of waste handled at Vestbase?
- How are these forms of waste managed?
- What characterizes the RL processes of the types of waste managed through Vestbase?
- How do these wastes, along with RL processes, create value in the WM network?

The research questions are linked to each other, meaning that solving the first research question, gives the presumption to solve the next and so forth, in accordance with the exploratory research design.

The first research question is purely technical. It seeks to evoke and help classify different types of waste. This is the foundation for further research and analysis. The second research question seeks to evoke features of WM at Vestbase. These sets focus on organizing factors regarding waste. The third question aims to develop understanding how this managed waste may be interpreted as 'reverse logistics'. This involves importantly how waste is transformed through a flow thereby creating value.

As a final point, based on a developed understanding from analysis directed by the three preceding research questions, an overall understanding is sought as to how the management and transformation of waste, viewed as a SCM system, is associated with "value" from a customer perspective.

1.4 Relevance of the study

This study seeks to provide a fresh and provocative view of waste at Vestbase, a source of value rather than simply "garbage" and costs. From initial inquiry with business it seems that industry has already clearly understood the value that lies in WM. Therefore the contribution of this study will be to conceptualize a customer value based understanding of WM taking into consideration features of RL.

Similarly, in academic perspective this study will contribute to develop theory in WM by integrating it with RL and customer value approach from a SCM perspective with focus on inter-organizational integration. In practical perspective new definition of waste, waste management and a model of WM will be developed that may provide foundation for developing waste processes by seeing waste as not only cost, but also value.

1.5 Limitations of the study

There are certain limitations in this paper. The limitations are divided into methodological limitations and limitation of the researcher.

Methodological limitations: The first methodological limitation is the lack of consistency of data collection. Some of the respondents were not available for interviews according to the pre-decided schedule, thus, those interviews had to re-schedule. Consequently, there

was a lack of consistency in data collection. Therefore, according to the data triangulation method of Yin (2009), the data triangulation of this study could be debated.

Moreover, one of the key informants did not show up for interview. Since the informant was not available, the information was collected from another informant, which was not the principal choice of the researcher. Therefore, the validity of those particular data could be discussed.

Furthermore, this study analyzes only a single industry (off-shore and on-shore waste from oil exploration). Therefore, it is difficult to apply the findings of the study in other industries like MSW, EE-waste and all other types of wastes. A single industry analysis helps researchers to find out more accurate, specific and detailed information to be familiar with the nature of the industry and relationship between key actors of the industry (Voss et al., 2002). Therefore, a single industry analysis provides researchers with high degree of internal validity. However, it also undermines external validity in other hand as a result its findings can be difficult to be applied in other industries (Voss et al., 2002).

In addition, this exploratory case study (building theory from case) is conducted where the phenomenon is evaluated has no clear, single set of outcomes. The outcomes which are suggested by the author are based on empirical investigation and backed by relevant reviewed theories. Therefore, distinctive solutions might be achieved for the same case study using other research methodologies.

Limitations of the researcher: The notable limitation of the researcher is limited access to data to the selected organizations. Some of the key informants were apathetic to share necessary data despite of the confidentiality agreement between the researcher and focal firms. Therefore, with more access of necessary data, it might have given better outcome for this study.

2.0 Chapter Two: Literature Review

2.1 Introduction

A few decades ago, it was unthinkable that we can create different energy sources from everyday waste that we throw out (Muir, 2010). This research is conducted in the context to explore how value in created from waste management in relation with logistics. To achieve this objective, the literature review is divided into several parts. All of these parts are interrelated and described in a consistent manner. The literature review focuses on: what has been written before related to the topic of interest; what has not been written, which indicates the gaps in literature; and finally what is the contribution of this research to fill up the gaps found in the literature.

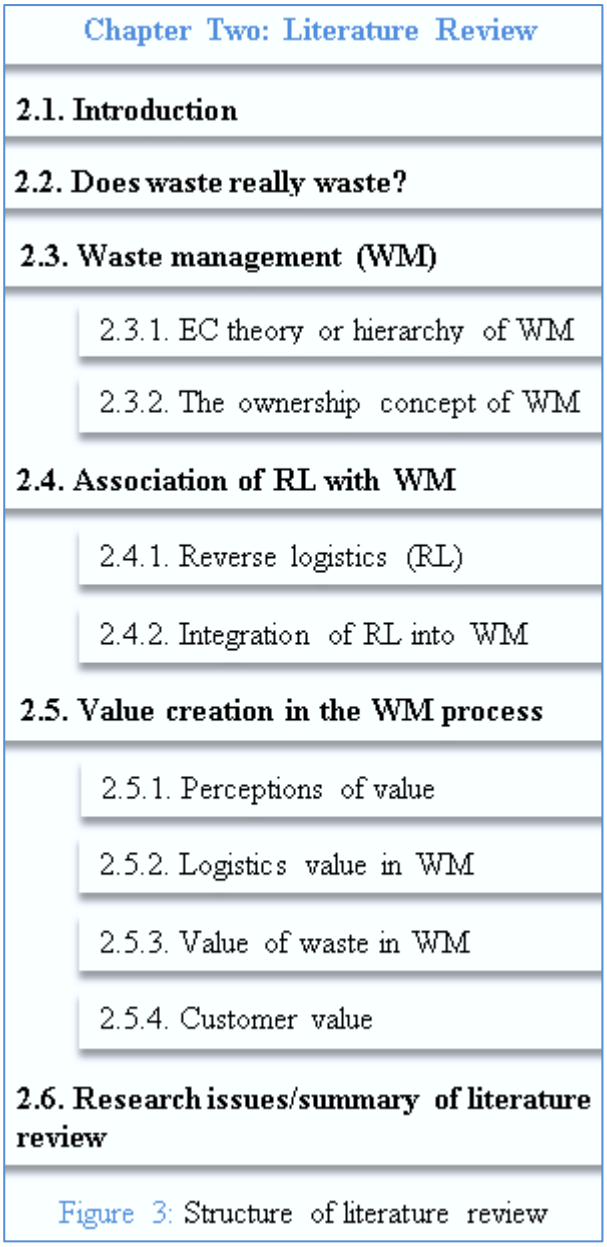


Figure 3: Structure of literature review

First, it starts with the overall views of waste with legal definition. This legal definition is important because it gives an idea what can and cannot be treated as waste. Second, this definition of waste is further extended to the management of waste and its relation with RL. Third, there is an overview of customer value in relation to RL and WM. Finally, this paper shows how value is recaptured from waste and the inter-relation among parties in the waste management process.

2.2 Does waste really mean waste?

Definition is always important in any area of study. It is predominantly important in the area of regulatory control, as it is important to define what should and should not be controlled. According to Fleischmann (2001), from a legal perspective the definition of waste is important because import of waste is often regulated with strict regulation. Cheyne and Purdue (1995), state that the legal definition needs to be adequately widespread to describe all actions that what should and should not be regulated, but not so widespread that can result excess-regulation. There are different views to the appropriate definition of waste, and the matters associated with proper regulation of waste (Smith, 1993).

The notion of waste seems clear and obvious. The European Council (1991) defined "Waste shall mean any substance or object in the categories set out in Annex I which the holder discards or is required to discard" (p. 33) (see table 1, appendix B). This Annex I consists of sixteen levels of wastes. Based on this definition, Pongcraz (2002) stated that, one of the methods to define waste is by listing activities or substances that fall within the range of abovementioned defined categories. However, Pongcraz and Phjola (2004) argued that the definition of waste in Annex I barely supported the selection of effective definition of waste and its management process. The authors argued that in Annex I, the term waste would be interesting to replace as "a thing that its holder is to discard" (p. 68), meaning that the waste is already existed and the holders intend to throw away. It replicates a disparity of the meaning of waste minimization, is to avoid waste generation at the first place. In addition to this, the authors argued that, "minimizing the amount of things that the holder intends to discard" (p. 68), does not necessarily indicate the notion of waste prevention. Otherwise, people would be encouraged to reuse, resell, or remanufacture the items they discarded.

Hansen et al., (2002) reports that, in the 1975 version of EC Waste Directive used the term dispose instead of discard and defined waste as "any substance or object which the holder disposes of, or is required to dispose if pursuant to the provisions of national law in force" (p. 3). The modified definition of European Commission's, (2012) definition of waste is shown in figure 1. The transformation of dispose to discard immediately raised questions that what is the difference between these two and why it is important to substitute them. It

became a debatable issue to many researchers. Predominantly, both dispose and discard mean to get rid of something, but many lexica suggest that the word dispose means to put the object in a suitable place. On the other hand, discard has the indication to reject something, which is useless.

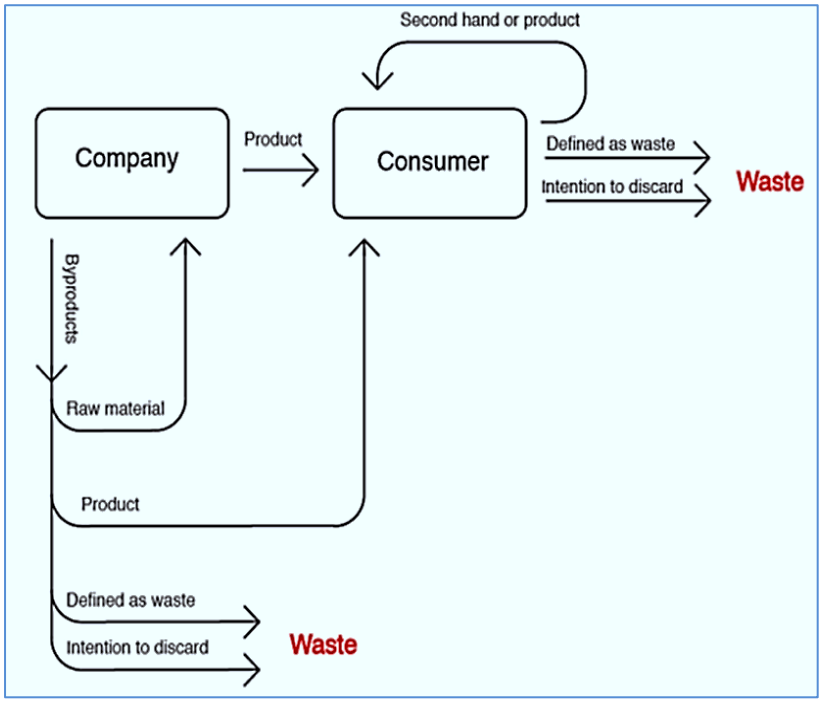


Figure 4: Illustration of EU legal definition of waste (European Commission, 2012, p. 6).

This figure indicates how materials, as transformed by companies and consumers, may ultimately become waste. The waste generation is defined in two perspectives, consumer and company. In company perspective, the manufacturing process produces some by-products. Some of these by-products are used as raw materials to the production process. Some other by-products are considered as product to the consumer and delivered to them. The rest of the by-products are defined as waste and intend to discard.

Similarly, in the consumer perspective the waste is defined what the consumer left after using the products. Some of the materials are sent back as second hand product. The rest of the materials are considered as waste. This waste object the holder discards, intends to discard or is required to discard.

However, Cheyne and Purdue (1995) argued that the purpose of changing the abovementioned waste terms in EU directives was to broaden the activities into the directive and include the widespread possible acts of getting substances or objects from the discarded objects. Pongcraz and Phjola (2004) claimed that the waste definition in EC Waste Directives is not precise enough in connection to recycling industry, which results in trade barriers. Consequently, each member of EU state had to define waste in their own way for some specific waste materials. Therefore, a suggested definition by Lox et al. (1994),

> *"Either an output with (a negative market) no economic value from an industrial system or any substance or object that has been used for its intended purpose (or served its intended function) by the consumer and will not be reused"* (p. 78).

This definition describes the term waste based on its function. It indicates that waste is an object or substance that is unwanted and created to be waste. Similarly, it advocates that a product was designed for a specific purpose, when the purpose is fulfilled, it turns into waste. It may still functions, but not used any more or lost its original properties and unable to fulfill its function anymore, thus, it is discarded. Therefore, there is a lack in most definitions that they barely suggest creation of waste should be avoided and it is something valuable instead of unwanted. This is known, but these definitions failed to point out the fact.

Yet, there are other notions of wastes. Gourlay (1992) exemplifies that a dollop of mustard left on a plate becomes waste because the owner does not want to use it. Before it was considered waste, neither it was useless nor lost its value. Therefore, Gourlay argued that waste is something what its owner does not want or failed to use. Pongcraz and Phjola (2004) argued that, again, it is a human related definition that does not explain the concept of production of waste. For example, a by-product or a secondary product is created from the manufacturing process, which does not mean that it was created from carelessness. The production process certainly involved some by-products, heat, wastes, emissions and some of them cannot be captured. These by products are sometimes unavoidable and yet not possible to use them, for instance, producing electricity from waste is one of the best interests of a power plant. This electricity production produces some certain heat, which

can be considered as waste but unavoidable because the technology is not efficient enough to transform every bit of thermal energy into electricity without any waste heat. This waste heat is wasted does not mean that the power plant does not want to use it, or fails to use it, rather it is not possible to avoid it.

Most of the definitions of waste are emphasizing one area and giving up another and therefore it creates confusion. There is no standard definition of waste that can clearly define the term waste with its specific characteristics. It might be useful to define waste in other relationship, which is not related to material objects. Stanbury and Thomson (1995 conducted a survey on government waste. The authors were surprised to find that "few authors bother to define the term. The authors offer plenty of examples, of course, but seem to assume that the concept is well understood" (p. 418).

Stanbury and Thomson, (1995) reports that former Vice President of USA, Al Gore (1993), defined the term waste as "the average American believes we waste 48 cents of every tax dollar" (p. 418). Similarly, McKinney (1986) defines waste as "the unnecessary costs that result from inefficient practices, systems or controls" (p. 2). Moreover, Baran (1959) defines waste as the difference between the output, which would be obtained if all productive factors were allocated as best and highest uses under rational social order, and the level that is actually obtained.

McKinney's (1986) aforementioned argument indicates that waste is unnecessary, which apparently means avoidable, but fails to explain the term "inefficiency". Stanbury and Thomson (1995) argue, eliminating waste can be costly. Therefore, it would be wasteful to try to eliminate all waste. Baran (1959) enhances the idea that waste is measured by the gap between what is acquired and what could be acquired. Again, Pongcraz (2002) mentions that Stanbury and Thomson (1995) explain that the term waste is derived from the Latin uastus, which means to ravage, to leave desolate, or to fail to cultivate (p. 420). Therefore, Pongcraz (2002) argued that technical inefficiency is probably the closest in meaning to traditional usage of the term waste.

In non-technical point of view McHale (2000) questions, which physical parts and products can be lawfully regarded as waste? The aforementioned Annex I includes a lists of sixteen categories, and thus any particular industrial remains is included in Annex I, can

be treated as waste. However, Pongcraz (2002) argued that the classification in Annex I itself states that "the inclusion of a material in the EWC does not mean that the material is a waste in all circumstances" (p. 66). Similarly, Bontoux and Leone (1997) argued that until now European Communities also recognizes that there is no satisfactory definition that indicates when a products becomes waste, nor when a waste becomes a product.

Therefore, Pongcraz (2002) suggests that there are important questions asked by Gourlay (1992), such as, "what, then, is waste? Are there any common features to characterize waste that justify one designation? Is there any common solution to the problems that others posed?" (p. 78). Ellwood and Patashik (1993) lightheartedly declare that waste, like beauty, is in the eye of the beholder.

Summary: There is no clear single definition that can undoubtedly define what waste is. Some authors defined waste based on its purpose or function. Others defined it based on its performance. If the producer or holder has no future purpose to use any object or material, it turns into waste. Similarly, when the object or material does not perform in respect to its original purpose, it too turns into waste. Perhaps, it is not possible to define waste that can satisfy all, because the term 'waste' is quite subjective.

The definition depends on in what purpose and context the object is defined. The object or material is waste to someone, is considered as value to others, for example, waste oil is considered as waste by the oil producer but it is valuable (means of energy recovery) in a cement plant, where oil waste turns into energy. Therefore, it is one of the areas of interest in this paper to explore 'does waste really mean waste?', and accordingly, based on the findings, re-defining waste. Moreover, while the value of waste is subjective, it indicates that the value from waste depends on how the waste is managed by the holder or possessor. Therefore, the next section addresses management process of waste.

2.3 Waste management (WM)

Problems with the management of waste have been put forward throughout the history of human civilization. A number of old documents evidence that the practice of throwing garbage in the roadways was a common scenario in former centuries. The deficiency of plan to WM, Europe faced serious consequences on human well-being. According to

Tchobanoglous et al., (1993), the plagues spread out as a consequence of the lack of plan to control rats, flies and other vectors of diseases from improper storage of waste. Fuller and Allen (1996) argue that waste is an inescapable part of the product of the resource conversion process and the materials as recycled as part of the RL help to support sustainable development to the effort to manage waste.

The history of WM is relatively old but the growing concern of managing industrial waste to recapture value developed few decades earlier. More specifically, the literatures which contributed on WM are quite recent and in an ongoing development process (Muir, 2010). Most of the studies conducted on WM focus on municipal, solid waste and greenhouse gas emissions from WM (Eugene et at., 2011); factors influencing regional municipal solid WM strategies (Wang et al., 2008); and solid WM by application of A Waste Managements' Efficient Decision (WAMED) model (Moutavtchi et al., 2010).

Traditionally, most of the manufacturers were not responsible for the products after they sold to the consumers (Liu, 2012) and thus large amount of used products, which were dumped, caused considerable damage to the environment. Thus WM has got increased attention. Pongcraz (2002) argues that WM, as it is understood today is the collection, transport, recovery and disposal including the supervision of such operations and after-care of disposal sites.

Pongcraz (2002) exemplifies that in case of industrial waste, mining waste, and electricity-generation waste, sometimes, agricultural waste, the waste is considered as a by-product of some economic activity. Thus, the study of considering by product is not waste is a newly emerging field. Most of these activities for the management of waste the requirements are heavily regulated. Sometimes the main objective is to utilize, disassemble, or safe disposal of waste. On the other hand, some other cases the main objective is to avoid, substitute, or minimize the waste production.

All these activities require different actions to manage waste differently. Some WM plans have to be in place for the existing waste. Some other WM plans have to be planned before the waste is produced. Therefore, WM is not the only option that how the waste will be treated, neither, it is not the only service for waste removal. Pongcraz (2002) argues that it

is important to consider and describe the manner in which waste is described and suggests that the way it is going to be acted upon.

The Council Directive 91/156/EEC of the European Council (1991) defines "Waste management shall mean collection, transport, recovery and disposal of waste, including the supervision of such operations and after-care of disposal sites" (p. 33). This definition of WM has similar characteristics to the definition of waste mentioned in section 2.2. It emphasizes the management of existing wastes and its minimization to minimize the potential impact. There is no confusion that this approach of WM is important to protect human health and environment.

However, Pongcraz (2002) argues that this approach does not go into the depth of the concept of waste and explain well. Cheyne and Purdue (1995) argue that the WM approach should be concerned not only with final disposal but also with the whole sequence of waste creation, transport, storage, treatment and recovery. Therefore, WM policies should deal with a wide range of policies, for instance waster elimination, reduction, assignment of obligation, concern over care, collection, transportation and disposal.

Similarly, WM is the collection and processing of waste that has no longer any reuse potential (De Brito and Dekker, 2003). Thus traditionally the main purpose of WM seems to be to remove waste. There are numerous international laws of WM. These laws mostly, with few exceptions, focused at regulating the removal of waste instead of avoiding its generation. However, EC has shifted attention to the policies and regulation to minimize the generation of waste (Tromans, 2001).

Based on this idea some argued that the disposal of waste can be seen as final process of a substance that has been extracted from the environment (Campbell et al., 1993). Most of the EU action regarding waste is based on legislative measures. Although all of actions have prevented in some worst case scenario of WM, the waste generation is still substantially high. There are concerns that the WM plan has not achieved its highest goal and it is still not pleasing (European Communities, 1999).

The WM policy is undertaken based on hierarchy of waste. According to European Council (1991), the WM principles are: waste prevention; recovery; and safe disposal

shows in section 2.3.1. Similarly, Kirkpatrick (1992) proposed WM, re-use, re-cycle, incineration, and disposal.

2.3.1 European Council's theory or hierarchy of WM

The WM hierarchy (European Council, 2008), based on the directive 2008/98/EC, sets the basic concepts and definitions related to WM, such as definitions of waste, recycling, recovery. The WM hierarchy in figure 2 indicates that the strategy emphasizes the prevention measures, recovery and disposal. In the recovery phase the theory deals with several measures such as preparing for reuse, recycling and other recoveries.

Figure 5: The WM theory or hierarchy (European Council, 2008, p. 1, directive 2008/98/EC on waste).

Prevention: Waste prevention takes place on the top of the WM hierarchy (Figure 2). It is the most desirable option because if there is less waste; there is less to deal with. Pongracz, (2002) mentions, Riemer & Kristoffersen (1999) suggest, the following three criteria of waste prevention based on the OECD agreement. Preventing and or reducing generation of waste; improving quality of waste; and encouraging re-use, recycling and recovery.

Waste prevention is the key factor in any WM strategy. The highest priority should be given to reduce the amount of waste generated at source and reduce the hazardous content of that waste. Waste prevention is closely linked with improving manufacturing process and influencing consumers to demand greener products and less packaging.

Re-use: Re-use of waste is the second priority in the WM hierarchy. According to the European Commission, Lox (1994) mentions, "Re-use is use, for the second or more time,

of a product for the same purpose, under the same form and with the same properties of the material as the first use, the material having constantly remained under the same form between several uses" (p. 33).

European Council (2000) defines, "Re-use means any operation by which components of end-of life vehicles are used for the same purpose for which they were conceived" (p. 33). Based on the European Council (1991) Annex IIB the re-use in the legislation is shown in table 8 in Appendix B.

Recycling: Recycling is a process where waste material turn into new products. The basic purpose of recycling is to reduce the use of potential useful material, reduce consumption of fresh raw materials, reduce energy use, water and air pollution. The European Council (1994) defines, "recycling shall mean the reprocessing in a production process of the waste materials for the original purpose, or for other purposes, including organic recycling but excluding energy recovery" (p. 34).

However, the term 'recycle' is basically derived from the natural cycle of water or carbon (Pongcraz, 2002). Thus recycling is a complete closed and permanent cycle. Nonetheless, it is difficult to recycle some materials and bring back its original form for example, glass is not recycled to sand and limestone. Thus, the term recycling hardly compatible with its original contexts because recycling only occurs when a secondary material is converted into a new product or is utilized in another way. Therefore, recycling is one of the most important activities to reclaim value form waste.

Incineration and disposal: According to European Council (1997), incineration is "the main alternative disposal method to landfill" (p. 39). The council describes incineration as, "Incineration produces toxins, and heavy metals. To prevent their release, expensive filters must be installed in incinerators and used filters with highly concentrated contamination, together with the quarter of the wastes original weight, must still be landfilled" (p. 34).

Disposal is the last activity in the WM hierarchy. Although landfilling technology is advanced and efficient, but it produces methane and that can be up to 60 times higher than CO2. According to European Communities (1999), both disposal and incineration of waste

are potentially harmful for the environment and humans. Based on the European Council (1991), the table 8 in Appendix B shows the waste directives of disposal operation.

According to the European Topic Centre on Waste (ETC/W) of the European Environmental Agency (1999) measures of waste minimization includes waste prevention, internal recycling, improvement of waste quality, and re-using for the same purpose. On the other hand, there are other WM measures include external recycling, sorting, re-using for another purpose, and energy recovery (European Topic Centre on Waste, 1999). However, this definition of WM hardly suggests the role of WM.

Pongrácz and Pohjola (1999) claim that this management of waste indicates control of activities, while the expression of WM semantically suggests that it is control of materials. They raise the question that if the aim of managing waste is to secure the end process of any waste, what would be the end?

However, Pongrácz & Pohjola (1999) provide a clear concept of WM than can answer the previously raised question. The authors suggest that the term WM should be understood as a system, which works as a medium for making changes in the way people behave with respect to waste. Furthermore, Pongcraz (2002) conclude that WM can be understood as: "waste management is the control of waste-related activities with the aim of protecting human health and the environment and resources conservation" (p. 105).

Moreover, all of these above mentioned definitions of WM broadly focused on protection of the environment, human health and natural resources. They also focused on re-use, and recycle, and other recovery. These definitions and concepts of WM are useful which is not deniable. However, considering value perspective, how these wastes are collected and its relationship with logistical activities is not discussed. The logistical activities in case of WM can be characterized by RL. These are the areas where value is created in the RL process. The details of the relationships between WM and RL are discussed in section 2.4.

2.3.2 The ownership concept of waste management

The life of an object or material begins and ends based on how its owner defines the purpose and the expectations of performance of the object or material. It is mentioned earlier, when an object is failed to perform in respect to its purpose and abandoned by its owners is defined as waste. Pongcraz (2002) describes the relation types between human and objects or materials can be described into three ways such as designer-type of relation, producer-type of relation and owner-type of relation.

This section describes ownership concept of WM, therefore, among the three abovementioned relationships, only the owner-type of relation is considered for explanation. According to Pongcraz (2002) the owner assesses the performance of the object or material and it is also possible that the owner can re-assign a new purpose for the same object. Therefore, the term 'ownership' is to be understood as an individual or private ownership.

Ownership in WM is relatively an ethical issue. Pongcraz (2002) mentions according to Oksanen (1998) the institution of ownership has conceptual and practical implications, which involves, the ethical considerations of what one is allowed to do with one's property. However, the purpose of this study is not to study the institution of ownership, but its implications on WM.

Earlier mentioned, The European Council (1991) defines "waste shall mean any substance or object in the categories set out in Annex I which the holder discards or is required to discard" (p. 33). However, Gourlay (1992) argues that waste is something what its owner does not want or fails to use. From this definition, it can be argued that the performance of the material or object might be useful at a little extent, but is considered as waste because the owner no longer wants to own or use it. Similarly, Pongcraz (2002) argues that any object turns into waste simply because its owner does not want to use any more. Consequently, it can be argued that an object or material can be recognized as waste either when it has no owner or no specified purpose.

The concept of ownership in WM is clear and obvious is EC waste directives. European Council (1997) stated that the waste producer, importer, distributor and consumer should

bear the specific share of responsibility to prevent, recover and disposal. Based on this theory each owner or actor is responsible for managing the waste when holding it as its owner. Therefore, the owner's active participation is important in proper WM and reclaims value from it. According to Thomas (2001) it is significant that how well the owner manages the waste, not just how many people participate in the process of WM.

Earlier discussed, what is waste to someone, does not necessarily mean waste to others. It can be argued that the value of waste depends on how useful the waste is and how much effort is given to recapture value. Different owners treat waste differently and thus transfer of ownership is important.

Pongcraz (2002) argues that many waste items are not transferred to its new owner because the current owner does not get attractive return. Considering this argument, the waste is only temporarily useless because the owner does not want to transfer it. It might have value to another owner but it is unexplored due to failure of the current owner to handover. On the other hand, when there is a new owner available for waste, after fulfilling the purpose of its current owner, it can be assigned for a new purpose to a new owner. The waste has no value only during the interval before assigning to a new owner for its new purpose. Re-using or closed-loop recycling is such an example to reclaim value from waste.

Therefore, based on the ownership definition of EC waste directives waste can be a useful object when it is transferred to its new owner. However, Pongcraz (2002) raises an important question that, since this waste item is transferred to a new owner, would this mean that it becomes non-wastes? The term non-waste is used by Bontoux & Leone (1997) to identify the ultimate waste. Precisely, can it be possible to create value from the waste? This can be answered with simple thought that it depends on the intention of the current and future owner. If the purpose of the future owner is to landfill waste then it does not necessarily add value and vice versa.

Summary: The WM theory is determined by several influencing factors such as, economics, logistics, legislation, availability of landfill space and desire to adopt more effective resource management practices. However, the relative necessity of waste management is attached to the environmental considerations for example, to protect human

health and environment. In addition to this, the WM theory indicates control of activities, while the expression semantically suggests that it is control of materials. Though, preventing and or reducing generation of waste; improving quality of waste; and encouraging re-use, recycling and recovery indicate the possible value reclamation activities.

Nevertheless, based on the ownership theory, these value reclamation activities depend on the intention of the owner, whether or not the owner wants to reclaim value. Therefore, the holder should handover the waste to its new owner to reclaim value from it, because any object turns into waste, simply because its owner does not want to use any more, and when it is not reassigned. In addition, the value creation depends on how well the owner manages the waste. The process of managing waste certainly involves some logistical activities. The total value of WM also depends on the logistical activities and performance. Therefore, the research interest is to construct a new theory of WM focusing logistics and value.

2.4 Association of reverse logistics (RL) with WM

Some authors claim that RL is unlike WM. Others argue that there are similarities between RL and WM. Therefore, it is a debatable issue and needs to discuss in details. The basic purpose of this paper is to explore value in WM through RL. Thus, it is important to find link between RL and WM. To achieve this objective, first, RL is described in consistency with formerly discussed WM process, to find similarities and dissimilarities. Later, RL is extended into WM process to identify how RL is integrated into WM process.

2.4.1 Reverse logistics (RL)

Traditionally, a typical supply chain would be, a product is manufactured, and then is delivered to the downstream parties through the chain of manufacturer-distributor-wholesaler-retailer (Liu, 2012). Therefore, from a traditional point of view, supply chain mainly focused only supply of goods. However, Marisa et al. (2002) argue that today supply chain has gradually integrated more activities than supply alone. In the modern supply chain, environment, service and product recovery is integrated and segregated into two parts: they are, handling of products and components; and materials during the

recovery process (RevLog, 1998). It can be argued that these activities involve reverse logistics. Therefore, the recovery process can be characterized by RL.

History of RL started a long time ago (Fleischmann et al., 1997). The root of RL can be found from the American Civil war (Walden, 2005). There might be other literatures that recorded RL even earlier than American Civil War, but they might not have been scientifically recorded and not widely recognized. In the business world, RL did not get much attention until the last decade (Liu, 2012). The Council of SCM Professionals (CSCMP), formerly The Council of Logistics Management (CLM), published two relevant studies on RL in the early 90s. The first study was conducted by J. R. Stock (1998) on how to set up and operate RL program and in his book he also tried to find out the potential of RL.

However, in the second study Rogers & Tibben-Lembke (1999) collected and presented a wide range of statistics data from numerous RL businesses and categorized them by industry type. They defied RL as a reverse activity of logistics. According to the CLM, Rogers & Tibben-Lembke (1999) mentions, logistics is defined as:

> *"The process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements"* (p. 2).

However, although, RL includes all of the activities that are mentioned in the definition above, but the difference is that RL encompasses all of these activities as they operate in reverse. Therefore, the authors defined RL as:

> *"The process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal"* (p. 2).

Based on this definition it can be argued that, RL is a process of moving goods from the final destination or end user for the purpose of recapturing 'value' or 'disposal'. It also

includes re-manufacturing and refurbishing activities. It is clear that something has to be sent from the point of consumption to the point of origin to fulfill the condition as a RL activity. If there are no goods or material is sent 'backward', the activity probably is not a RL activity.

Likewise, Blumberg (2005) defines RL as the "full coordination and control, physical pickup and delivery of the material, parts, and products from the field to processing and recycling or disposition, and subsequent returns back to the field where appropriate" (p. 12). He develops a basic RL model to show how RL take place in the WM process (See figure 4).

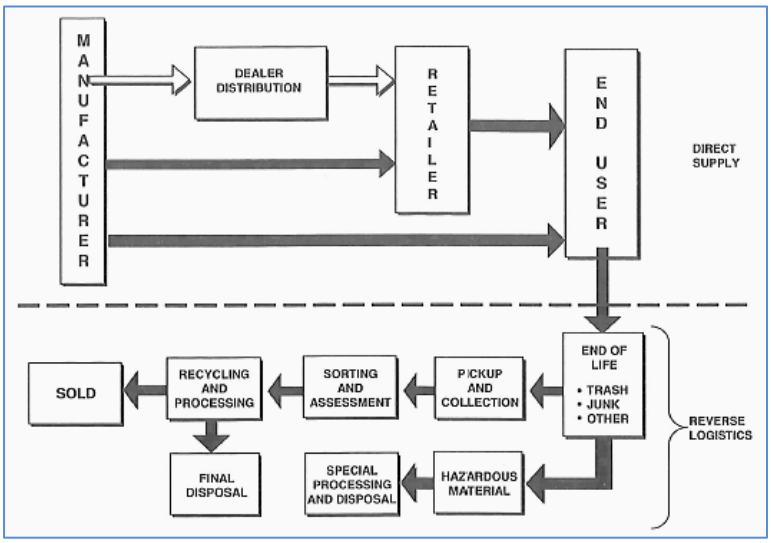


Figure 6: Independent RL processes (Blumberg, 2005, p. 13).

This figure is divided into two parts and separated by the straight dashed line. The upper part shows the logistics activities from manufacturer to end user. The lower part shows the RL activities. The RL simply deals with the return of unwanted materials and products to a central location for processing and further disposal. The basic model describes the activities of the return materials or waste of a traditional waste and junk dealer or service organization. These return materials are picked up and collected at a particular place, usually at the city, municipality, or local level. Before recycling and processing these waste materials are sorted and assessed to be sure that which is sellable. The things are not sellable are disposed.

Blumberg (2005) discusses that this model emphasizes the economic disposal of waste or trash through land or sea dumping or recycling. However, RL is not only the economic disposal of waste or trash, but simply something more than that. Rogers & Tibben-Lembke (1999) argue RL is more than reusing containers and recycling packaging materials. It includes redesign of packaging to use less material, reducing the energy and pollution from transportation. It too includes processing returned merchandise due to damage, seasonal inventory, restock, salvage, recalls, and excess inventory.

Moreover, Rogers & Tibben-Lembke (1999) argue that RL likewise includes recycling programs, hazardous material programs, obsolete equipment disposition, and asset recovery. Earlier mentioned, Pongcraz (2002) argues that WM, as it is understood today is the collection, transport, recovery and disposal including the supervision of such operations and after-care of disposal sites. Therefore, there is a clear link detected between RL and WM process. Hence, the relationships between RL and WM can be characterized as the logistics of WM. The detail of how RL is linked to WM is discussed in section 2.4.2.

2.4.2 Integration of RL into WM

RL is defined, by Rogers and Tibben-Lembke, (1999), as "the process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin, for the purpose of recapturing value or proper disposal" (p. 2). The authors argue that, precisely, RL is a process of moving goods from the final destination for the purpose of recapturing value or disposal.

However, according to De Brito and Dekker (2003), WM is the collection and processing of waste that has no longer any reuse potential. From the RL definition of Rogers and Tibben-Lembke (1999), it can be argued that the purpose of RL for collecting and processing return material is, first, to recapture value and, second, disposal if the return materials do not carry any value. However, the WM definition of De Brito and Dekker advocate that the purpose of collecting and processing waste is disposal or incineration because it has no reuse potential. Therefore, it is an arguable issue and it needs to analyze through detail description.

De Brito and Dekker (2003) claim that RL differs from WM because the last part of RL definition of Rogers and Tibben-Lembke (1999) mainly concerned with the efficient and effective collection and processing of waste, that is, products for which there is no longer any reuse potential. De Brito and Dekker support their argument by the definition of waste, that is, waste is something which has no re-uses possibilities. However, Shakantu et al. (2002) argues that there are similarities between some of the processes used by product recovery networks and waste disposal networks. Similarly, the WM concept mentioned by Pongcraz (2002) points out that today WM is the collection, transport, recovery and disposal of waste. This concept of WM backs the argument of Shakantu et al. (2002) because the involvement of RL is essential in the product recovery and disposal network. Consequently, it can be argued that there is a connection between WM and RL.

Cherrett et al. (2010) claim that the similarities between RL and WM is most evident in the supply side where used products are collected from many sources and need to be consolidated for further processing and transportation. The authors further argued that there are major differences exist between these network types on the demand side. However, Fleischmann et al, (2000) argue that a flow of recovered products is directed towards a reuse market and waste streams eventually end at landfill sites or incineration plants after various treatment processes. Cherrett et al. (2010) report that the following figure (5) shows how RL is integrated into the WM process.

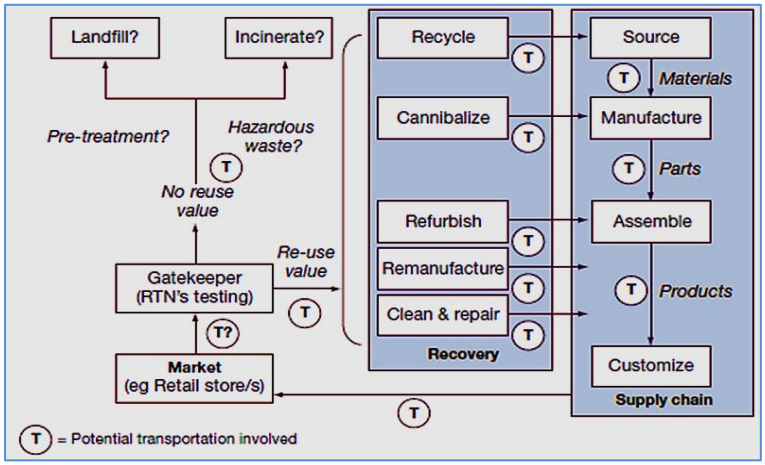


Figure 7: Recovery processes incorporated in the supply chain (Cherrett et al., 2010, p. 244, original source, Hillegersberg et al., 2001).

This figure shows the flow of recovered products in the RL process. The recovered products are directed towards reuse market and waste streams eventually end at landfill sites or incineration plants after various treatment processes. 'T' indicates the involvement of potential transportation. Thus, clearly, it can be argued that in this figure transportation is the main attribute of RL. Every aspect of movement of return materials need transportation, eventually it directs RL. Some extents these flows of return materials back the previously mentioned WM and RL relationship.

Similarly, Rogers and Tibben-Lembke (2009) develops a table, which includes a list of activities, shown in figure 8, that are generally considered the central of RL processes. It is observed in the table that reverse RL include return to supplier, resell, salvage, recondition, refurbish, recycle and landfill etc.

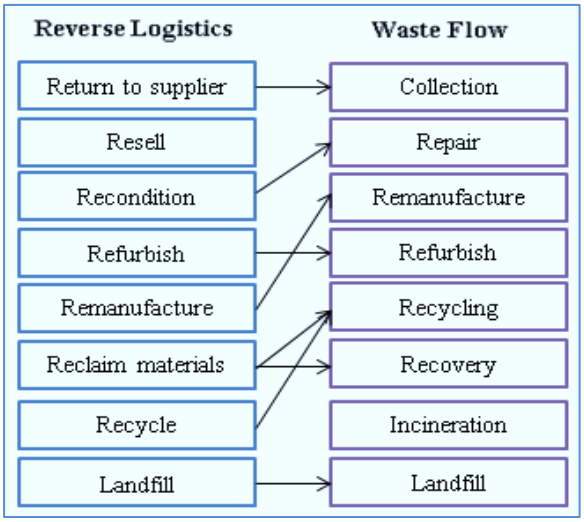


Figure 8: Relationship between waste flow and RL activities (modification of original work of Rogers and Tibben-Lembke, 2009, p. 10, and Cherrett et al., 2010, p. 244).

Likewise, return materials or waste recovery includes all the RL activities, which are mentioned in the abovementioned table. Therefore, it can be argued that RL is integrated into the WM process. However, De Brito and Dekker (2003) argue that depending on the type of reverse process, products may not necessarily be returned to their point of origin, but to a different point for recovery. This idea supports the WM practice, where the waste materials are returned at the point of origin or in a different recovery point. In a WM process the waste materials might be sent back to the treatment center or disposal sites instead of its origin. This involves RL activity.

Correspondingly, Cherrett et al. (2010) argue that the delivery of return materials back to disposal sites and treatment centers is a natural extension of RL. The authors further argue that better integration of WM processes into the overall RL process could help to reduce the negative transport effects. Like the theory of Hillegersberg et al. (2001), the arguments of Cherrett et al. (2010) characterize transportation is one of the attributes of RL. However, most of these concepts and theories exemplify the integration of RL into the WM. Consequently, it can be clearly argued that RL is integrated into the WM process.

Summary: RL is integrated into the WM process. Some of the processes used by product recovery networks and waste disposal networks are similar. WM is the collection, transportation, recovery and disposal of waste. Similarly, RL is essential in the product recovery and disposal network. Therefore, it can be argued that the value creation from WM in some extents depend on RL performance. The main purpose of this study is to unfold the value creation aspects from waste management process, which is a combination of RL and WM activities. Therefore, it is essential to analyze different perceptions of value in connection with RL and WM; and together how they create value in the WM process.

2.5 Value creation in the WM process

This section provides an overview of how value is created from waste and WM through RL. Besides, this section as well discusses the gaps in the literature, where there are areas of improvements and higher value can be created. The term value is fairly general, thus, it needs to specify which contexts of value are compatible to answer the research questions of this paper. Formerly mentioned that the purpose of this paper is not to show how much value is created form the WM process, rather to find out areas where value is created and how higher value can be created from waste management.

Thus, the first section is all about the perceptions of value. Therefore, while it is clearly known what ‘value’ is relevant to signify this research, the next three subsections explore logistics or RL value, value of waste and customer value in waste supply chain.

2.5.1 Perceptions of value

The term value appears to have several different meanings to almost every individual, company or organization (Rutner and Langley, 2000). Most dictionaries have between 10 and 25 meanings for the word value. According to the Concise Oxford Dictionary (1976), these differences in meanings are associated with the fact that the term value is also applied in other areas such as mathematics, ethics, music, physics and chemistry. Rutner and Langley (2000) mention that value is frequently thought of in the context of shareholder value or economic value concepts. These concepts relate, to the term value in a macro sense, to the overall economic value, that increases to the owners or shareholders value of an organization.

However, the purpose of this paper is to analyze the concept of value in relation with a specific business context, precisely, value creation in WM network through RL. There are definitions of value, among them two definitions, in the Webster's New Universal Unabridged Dictionary (1983) that seems to be suitable for the definition of value in business contexts. Value is the (1) quality of a thing based on which it is assumed as being more or less desirable, useful, estimate, important etc. and (2) fair or proper equivalent in money, commodities, etc., for a fair price, for something exchanged or sold. These two definitions can be explained in terms of monetary and non-monetary values, which are described below.

Monetary value: There are common features found in the aforementioned and some other business oriented value definitions. One common feature is the notion of exchange in monetary units. Broadly, the value of something may be measured by the amount of another item that a person or company is willing to exchange (Rutner and Langley, 2000). The authors further mentioned a number of characteristics such as equivalent price, exchange amount, and returns, which usually describes value. Two popular ways of measuring value are by measuring Return on Investment (ROI) and Return on Asset (ROA). ROI and ROA are quantified by the following formulas:

$$\text{Return on Investment, } ROI = \frac{Earnings - Initial\ Investment}{Initial\ Investment}$$

$$\text{Return on Assets, } ROA = \frac{Net\ Income}{Average\ Total\ Assets}$$

The details of the impact of logistics on ROI and ROA on value creation are discussed in the logistics value section.

Non-monetary value: Another common feature is the non-physical nature or idea of value. This means, value may be presented in the business process but not possible to possess or visualize physically. This definition defines value as *worth*, *usefulness*, *quality*, *desirability* and *importance* to the carrier. In this sense, value is bodiless, and thus it generates differences in meaning. These differences in meanings create complexity in quantifying value. In describing value, this complexity sometimes leads to substitute the concept of value with non-measurable alternative term.

However, Rockwell Automation (2008), the world's largest company in industrial automation, describes the term value in a combination of monetary and non-monetary term. This model is quite convincing to define the total value because it includes monetary value along with the usefulness of the products or services (utility) and the relevant importance of having the products or services. The following figure shows how these three types of values constitute the total value.

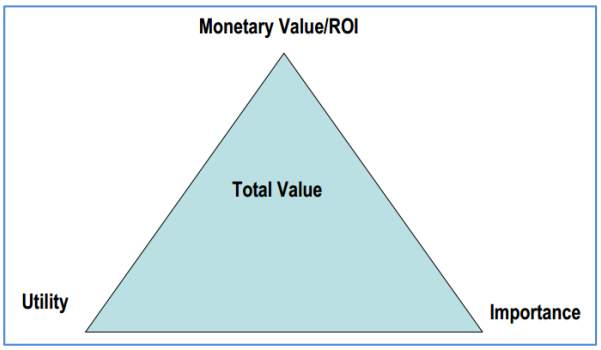


Figure 9: Fundamentals of value (Rockwell Automation, 2008, p. 15).

In this figure, the monetary value is expressed in terms of Return on Investment (ROI). This is the most common and quantifiable measure of value. This figure suggests that

value extends beyond monetary value, and should include two other important characteristics: utility and importance. From a utility standpoint, it indicates how the products or services meet the holder's or consumer's needs. It includes safety, performance, throughput etc. These factors are undeniably important to the holder or consumer but have little to do with the monetary aspect.

However, importance is the most difficult aspect to define, but in some cases the aspect that overrides the others or at least breaks any deadlocks. Importance includes for example, adherence to industry standards, environmental responsibility, sustainability etc.

2.5.2 Logistics value in WM

Making a strong business case in RL analyzing the notion of value is not easy (Mollenkopf and Closs, 2005). The reason behind this complexity is, logistics or RL create value but at the same time incur costs. Stock et al., (2002) argue that RL is often view as a costly slide show. However, Mollenkopf and Closs point out RL clearly have some cost implications, but it can be difficult to prove the impact on revenue.

RL includes all activities of logistics, but the difference is, simply they operate in reverse (Rogers and Tibben-Lembke, 2009). Therefore, RL is defined as a process of moving goods from the final destination for the purpose of recapturing 'value' or 'disposal'. Accordingly, value of logistics and RL is apparently substitutable with each other because both terms deal with logistics.

Rutner and Langley (2000) conduct a survey to systematically gather information about thoughts or practicing managers concerning their definition of logistics value. In the first part of the study it was asked whether the respondent's company had a specific definition of logistics value. Surprisingly, only16% of the respondents indicated that their companies have a formal written definition of logistics value. In the second part, once it was determined that the company had a definition of logistics value, the respondents were again asked to provide company's definition of logistics value. Some typical replies of logistics value are:

"(1) Providing the right product at the right place, time and place, without error, with consistency over time, (2) cost of utility, (3) improvement in time and place utility, reduction in cost, improvement in product presentation and (4) increasing the payback to the company via revenue growth, asset reduction, cost reduction etc." (p. 77-78).

Measurable or monetary logistics value: Mollenkopf and Closs (2005) conduct a survey, named Michigan State survey, to understand how RL creates value. This survey was conducted to unfold the hidden financial impact of RL. They argue that, to understand how RL can create value, it is important to understand both marketing and logistics components in the entire logistics process.

In a marketing point of view an effective returns operation can enhance customers' perceptions of product quality, minimize purchasing risks, and boost goodwill by establishing good corporate reputation. The detail of customer value is discussed in the last section in this chapter. In a logistics perspective, return products can be reinserted into the forward supply chain as refurbished or remanufactured products, or as repair parts. This utilization of return materials, thorough RL, can create additional revenue, reduce operating costs, and minimize the opportunity costs of writing off defective or out-of-date products. The process is shown below:

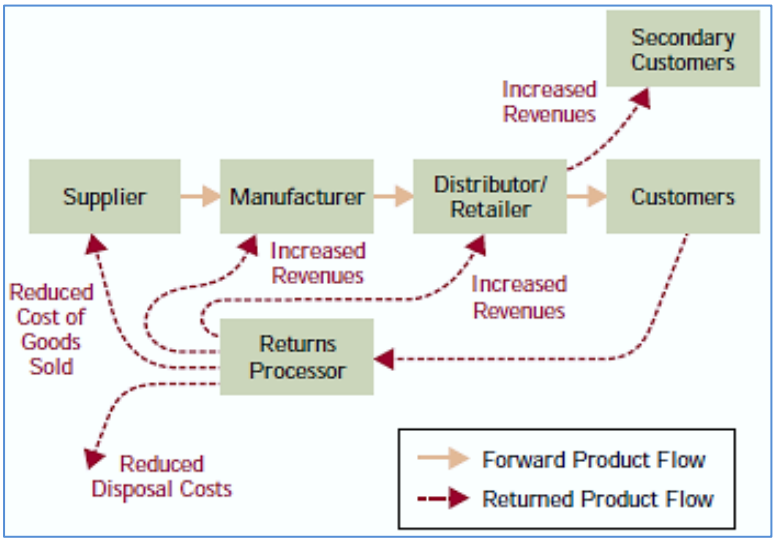


Figure 10: Impact of effective returns management in the RL process (Mollenkopf and Closs, 2005, p. 36).

This figure indicates how value is created in the supply chain network through RL process. The products flow start from supplier and ends to customer. The return products or materials are collected in the return processor. From the return processor, these return materials again distributed to different parties in the supply chain based on the potentials for further use. These reverse processes certainly cause cost to the parties in the supply network. However, Mollenkopf and Closs argue that clearly, the RL process must be recognized as more than a cost of doing business or as a cost minimization exercise.

The authors demonstrate the impact of RL in four ways. Revenue can be increased from secondary sale. Similarly, customers have an impression to companies' behaviors, and goodwill developed through RL and proper disposal of return products or wastes. This goodwill can create customer loyalty. Therefore, the goodwill earned by behaving in a socially or environmentally responsible manner can create real value. Moreover, cost can be reduced by reducing cost of goods sold and lowering operating expenses. For example, a major computer manufacturer has managed to reduce its procurement costs by recapturing usable parts from returned computers. Furthermore, better management of returns inventory can improve asset turnover. This model shows how the logistics value can be quantified. However, this model does not indicate the logistics impact on financial performance in specific.

Therefore, Munsami (2011) specifically suggests the financial importance of logistics from a company's return on assets (ROA). It is mentioned earlier that ROA is one of the ways to quantify value. The following equation can quantify ROA.

$$\text{Return on Assets, } ROA = \frac{Net\ Income}{Average\ Total\ Assets}$$

However, to show the logistics impact on ROA, Munsami (2011) expanded the basic equation, which is summarized in figure 7.

$$\text{Return on Assets, } ROA = \frac{Units\ sold \times selling\ price \times profit\ margin}{Current\ assets + fixed\ assets}$$

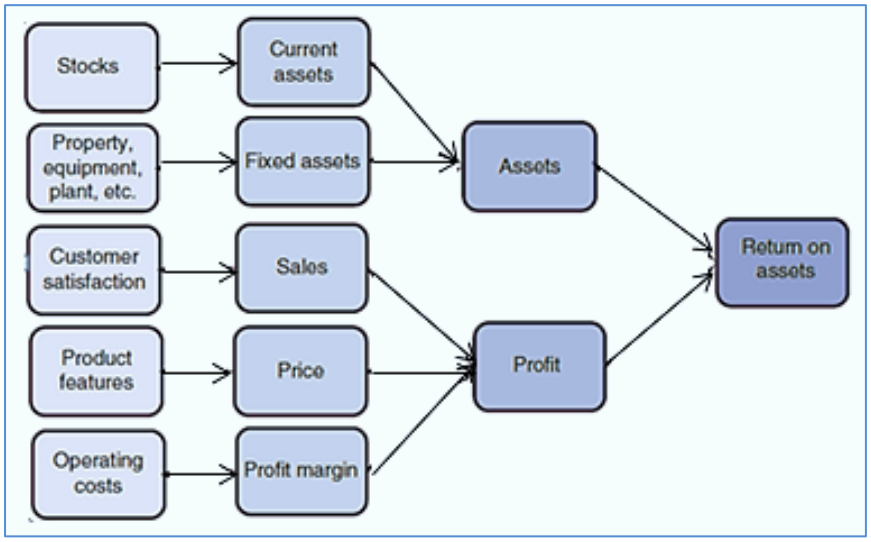


Figure 11: Influence of logistics on ROA (Munsami, 2011, P. 26).

Current assets: More efficient logistics services can reduce current assets by lowering stock levels. Consequently, lower investment in stock can free up cash for more productive purposes and reduce the need for borrowing.

Fixed assets: Logistics is a heavy user of fixed assets. It includes warehouses, transport fleets, materials handling equipment and other facilities. More efficient use of these assets can result considerable savings.

Sales: Supply of more attractive products, or delivering them efficiently to improve customer service, logistics can increase sales and give higher market share. In case of offshore oil-waste, WM companies recycle the waste and produce non-refinery oil, sand and gravel, which they sell and earn money. The detail of this is discussed in the empirical case description.

Profit margin: More efficient logistics reduce operating costs and directly increase profit margins.

Price: Logistics can improve the perceived value of products for example, enabling faster delivery, or shortening lead times of waste delivery. This can allow actors to create value at a lower price/cost to the waste-to-energy or other waste to value recovery activities.

Total (monetary and non-monetary) logistics value: Rockwell Automation (2008) model shows that the total logistical value consists of the combination of monetary and non-monetary values. It combines monetary value along with the usefulness of the products or services (utility) and the relevant importance of having the products or services.

Correspondingly, in the study of Rutner and Langley (2000) there were approximately 100 companies provided written definitions. Based on the definitions provided by the respondents, Rutner and Langley develop the following model. However, the following model is originally adopted form Woodruff et al., (1993). This model shows the total logistical value, which is the combination of numbers of non-monetary attributes of value creation along with the monetary unit.

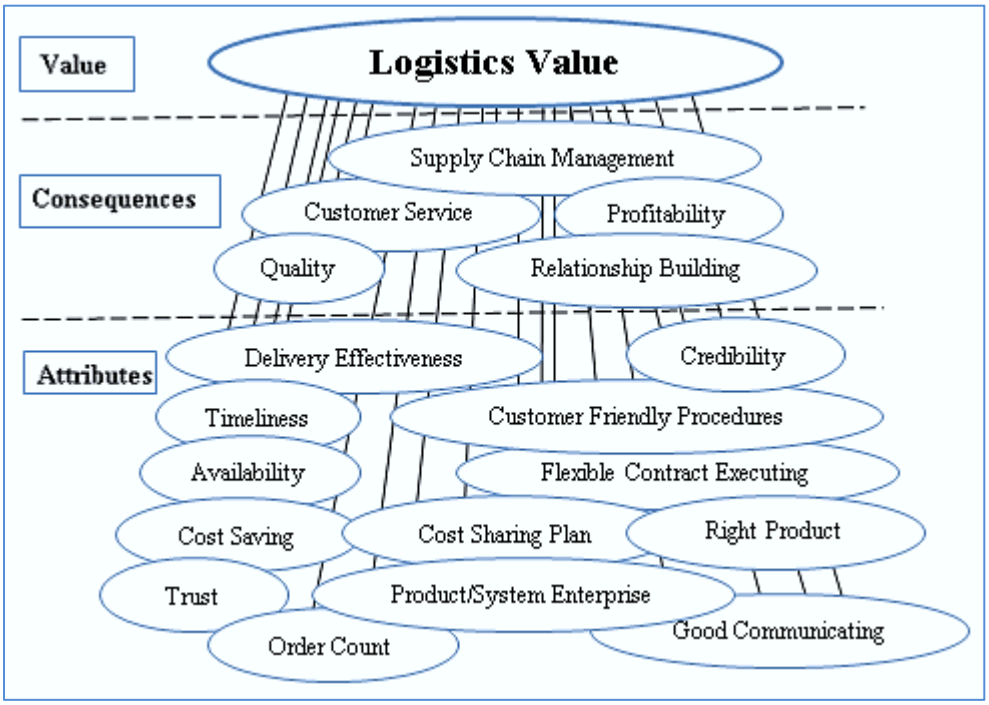


Figure 12: Means-end value hierarchy model of logistics value (Rutner and Langley, 2000, p. 79, original source: Woodruff et al., 1993).

In this figure, logistics value is shown in a combination of monetary and non-monetary values. The total logistics value is shown based on the means-end hierarchy model. The hierarchy is divided into three stages: attributes, consequences and value. The attributes are the features regarded as the characteristics that influence the value creation action. These attributes are the inherent part of value creation. The performance of these attributes influences customer service, quality, SCM, profitability and relationship building. These

consequences are the results of the action of the attributes, which establish logistics value. In this case, the logistics value is shown in a combination of monetary value and non-monetary value.

2.5.3 Value of waste in WM

There are several concepts of value described in section 2.5.1 in business and logistics perspectives. Earlier besides mentioned that value is very subjective and meaning of value depends on which context it is used. However, Trompenaars and Hampden (1997) define value as the degree of usefulness or desirability of something. This definition indicates that the presence of value in something makes it useful. The purpose of this section is to depict value creation from waste, consequently, the usefulness of waste in everyday life.

The EC waste directive 2008/98/EC divides waste and non-waste materials based on two categories: prevention and recapture. The prevention phase is called non-waste phase and a material is characterized as product. However, the life of a material in the recapture phase is considered as waste. This phase includes reuse, recycle, recover and landfill. Value creation takes place in this stage. The following figure (7) shows the value recuperation through reusing, recycling, recovery and landfilling.

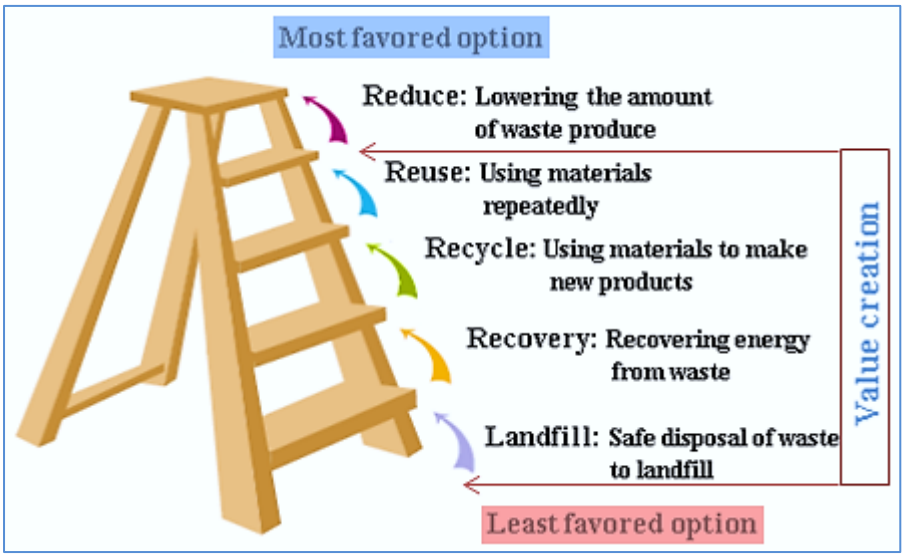


Figure 13: Value creation in EC waste directives (modification of the original work of CEWEP, 2013, p. 7).

The definition and description of prevention, reusing, recycling, recovery and landfill are shown in 2.3.1. Therefore, in this section a of many everyday examples are shown that depicts value of waste in waste management.

Reuse: The term reuse has the indication to repeat the use or service or action of an item. FOEEurope (2000) reports, many European citizens are willing to purchase or receive second-hand clothes, especially if there is a broader and better quality range available. In the UK, two-thirds of customers already use second-hand clothes (WRAP, 2012). Therefore, it can be argued that before considering a material as waste reusing of it can create value. NSCC (2007) reports, waste materials can be reused by the following ways:

Bricks and tiles: Bricks and tiles can be reused on-site for construction. Bricks which are not a good condition can be used as landscaping where structured load-bearing is not a requirement.

Timber off-cuts: Timber can be reused for floorboards, rafters, doors, window frames and fencing. Some timbers can be reused four times before disposal.

Packaging: Transport pallets can be reused rather than thrown away, as disposing of them results large void spaces, which significantly increases costs. Cardboard packaging can be reused for temporary internal floor covering to protect from site traffic, and loose timber can be re-sized and used for formwork.

Likewise, Kratzer (2007) argues that plastic bags, boxes and lumber can be reused; donate broken appliances to charity; offer furniture and household items no longer needed to people in need, friends, or charity; and old towels and sheets can be cut in small pieces and used for dust cloths. Moreover, plastic bags and wraps can be used for storing items; books and magazines can be donated to schools, public libraries or nursing homes; and newspapers can be donated to pet stores.

Recycle: Recycling means using waste materials to make new products. There are some of examples value creations from recycling in different sector.

Glass: FEVE (2011) reports that, in Europe including Norway, the average rates of glass collection for recycling is 69.59%. In Norway, the rate is 91.77 %.

Aluminum: According to International Aluminum Institute (IAI, 2009), in 2009 total aluminum production was around 56 million tonnes, where over 18 million tonnes recycled from scrap. IAI also forecasted that by 2020 metal demand is projected to have increased to around 97 million tonnes, where around 31 million tonnes will be recycled from scrap.

However, the recycling process incurs extra cost and emission too. Nevertheless, the recycling process of aluminum is costly and emits less greenhouse gas, IAI reports that compared with the production of primary aluminum, recycling of aluminum products needs as little as 5% of the energy and emits only 5% of the greenhouse gas. IAI mentioned the measurable and non-measurable value of aluminum recycling as, "Aluminum recycling benefits present and future generations by conserving energy and other natural resources. It saves up to 95% of the energy required for primary aluminum production, thereby avoiding corresponding emissions, including greenhouse gases" (p. 36).

Electronics: Similarly, Electronics TakeBack Coalition (2013) reports that according to EPA recycling 1 million cell phones can recover 24 kg of gold, 250 kg of silver, 9kg of palladium and more than 9,000 kg of copper.

Plastic: However, Jackson et al. (2006) report that in UK only 200,000 tonnes of plastic are recycled each year. However, this recycling does not happen inside UK, they are sent in China each year. They also reported that an estimated 9.2 billion plastic bottles are disposed of each year. Therefore, it can be argued that there are many initiative are taken worldwide to recapture value form waste but there are still more potential to recreate value from waste.

Shipping: Moreover, Mikelis (2007) presents, according to International Maritime Organization (IMO) from 1990 to 2006 there are 182,796,704 Gross Tonnage (GT) of ships are recycled worldwide.

MSW recycling in Norway: According to EEA (2013) in 2010 the country recycled 42 % or 967 000 tonnes of MSW. The amount of waste recycled decreased by 145 000 tonnes from 2003 to 2004. However, the total material recycling has increased from 37 % to 42 % between 2004 and 2010, peaking in 2008 with 44 %.

Recovery: Waste to energy is one of the examples of recovery attributes of waste. Waste to energy means generating energy from waste especially household and similar waste that remains after waste prevention and recycling (CEWEP, 2013). CEWEP (2011) reports, in Europe, about 20% of the waste generated in the year 2009 were incinerated in about 440 wastes to energy plants. The energy is in the form of steam, electricity or hot water. Electricity is distributed to the end-users while, hot water is sent to a nearby district heating network to heat homes, hospitals, offices etc. The steam is used by nearby industry in production processes. CEWEP (2013) reports that, "1 tonne of MSW can produce 1 tonne of brown coal or 0.330 tonne of hard coal or 250 liters of oil" (p, 18).

CEWEP (2013) reports, 50% of Paris, including the famous Louvre museum, are healed by 3 waste-to-energy plants. In Amsterdam, electricity generated by AEB waste-to-energy plant helps to provide green certified power for the tram, metro and city (CEWEP, 2013). In Germany, Cologne's cathedral and the best known icon, the Kolner Dom is illuminated at night energy from the city's waste-to-energy plant AVG Koln (CEWEP, 2013). In Netherlands, Alkmaar waste-to-energy plant delivers heat to the AZ football club's stadium, to buildings at the Boekelermeer business estate, and a further heating and cooling distribution project in Alkmaar (CEWEP, 2013). These are the few of many examples of waste-to-energy recovery facilities.

However, Rentizelas et al. (2014) argue that there is growing concern about the ashes produced from this process as they may contain toxic substances such as heavy metals. Nevertheless, the authors mention, some researchers again claim, these ashes may be used for several alternative uses, such as in cement or road infrastructure, instead of being landfilled. However, Bordonaba et al., (2011), McKay, (2002), Morselli et al., (2011) and Porteous, (2001) claim that due to the technological advancement and new stricter emissions regulations, many countries have reduced emissions to such an extent that it is no longer considered a significant source of pollution.

Therefore, waste to energy is one of the important uses of waste. However, the amount of generating energy from waste is not substantial comparing to the amount of landfilling of waste. Therefore, there is potential of using waste to produce further energy instead of landfilling.

Incineration and Landfill: According to the European Council (2007), incineration produces toxins. However, Petts (1994) argues that there are some specific benefits of waste incineration. It reduces the volume and weight of waste with high combustible content. Destruction and detoxification of combustible carcinogens, pathologically contaminated materials, and toxic organic compounds ease more suitable disposal.

Conversely, landfilling disposal is more harmful for the environment. Landfilling produces methane, which is up to 60 times greater than CO2 in its contribution to global warming. However, with the highly advanced technology some disposal can be beneficial for the environment for example, recycled ash in the forest returns valuable nutrients to the soil. Sakai and Hiraoka (2000) report that in Japan 75% MSW are incinerated produce 6 million tons of residual which is landfilled.

However, Pongcraz (2002) argues that the benefit form landfilling is less than the harmful impact on society and environment. Therefore, it can be argued that landfilling is not a favorable option and thus the EC waste directives place it as the least favorable option.

Nevertheless, according to Statistics Sentralbyrå (SSB, Statistics Norway, 2013), a total of 9.9 million tonnes of waste was generated in Norway in 2011, where 1.5 million tonnes were sent to ordinary landfills, while 0.6 million tonnes were deposited on industrial landfills. Therefore, it can be argued that there are areas of improvements in waste management system to ensure least landfilling and more recycling.

2.5.4 Customer value

The final purpose of any logistics system is to satisfy its customers (Christopher, 2011). Therefore, customer value is how customer perceives entire company's offerings. In addition, Supply Chain Management (SCM) deals with products or services it offers and value of various elements of this offering. In this sense, SCM is associated with customer

value. To create such a system, the basic objective should be to establish a chain of customers that can link assigned people from all level of organization directly or indirectly to the market place (Schonberger, 1990).

According to Christopher (2011), customer value can be defined as the difference between the perceived benefits from a products or services from a purchase and the total cost of the customer and success or failure of any business. Thus, the success or failure of any business is ascertained by the level of customer value that the company delivers in any specific market. Customer value indicates the performance of the product or services. In addition, Christopher (2011) argues that the performance of product or service is linked to the performance of the entire supply chain.

Linking customer value to supply chain strategy: Most traditional supply chains were designed to optimize the internal operations of the supplying company (Christopher, 2011) However, the author claims that according to the new supply chain perspectives the consumer is not at the end of the supply chain but at its start. The following figure shows the link between customer value and supply china strategy.

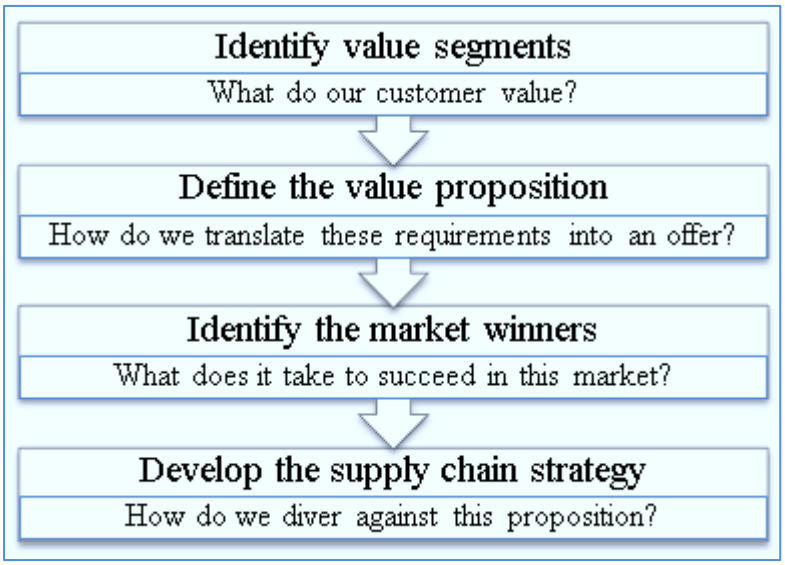


Figure 14: Linking customer value to supply chain strategy (Christopher, 2011, p. 39).

Identifying customers' service needs: To identify customers' needs Christopher suggested three strategies, first, identifying the key components of customer as seen by customer themselves. This can be identified by the recognizing the key sources of influence upon the

purchase decision. Second, establish the relative importance of those service components to customers. This can be done by discovering the importance customers attach to each element of customer service. Third, identify clusters of customers according to similarity of service reference. The simplest way of identifying customer segments is cluster analysis. Christopher (2011) explains, "Cluster analysis is a computer-based method for looking across a set of data and seeking to 'match' respondents across as many dimensions as possible" (p. 41).

Defining customer service objectives: To develop a market driven logistics strategy the main goal is to achieve service excellence in a cost effective and consistent manner. This indicates that to provide better customer service the efforts should be cost effective and consistent. Christopher (2011) describes, "The whole purpose of supply chain management and logistics is to provide customers with the level and quality of service that they require and to do so at least cost to the total supply chain" (p. 42). However, there are challenges to manage cost effectiveness and consistent customer service management. The first challenge is to identify the real profitability of customer. Second, to develop strategies for service that improves the profitability of all customers.

Setting customer service priorities: To manage the service levels perhaps the best way to take into account both the profit contribution and the individual product demand. Christopher (2011) proposes four strategies to manse customer service level. They are: seeking cost reductions, product high availability of products or services, reviewing the products movements and centralized inventory system.

Setting service standards: Setting customer service standards a supplier needs a clear and objective understanding of the customer's requirements. Christopher (2011) raises a question that, "what are the customer service elements for which standards should be set?" (p. 50). The effective standard must be defined by customer themselves. However, Christopher proposes the following attributes to meet the service standards, they are: measuring order cycle time, ensuring stock availability, eliminating order-size constraints, convenience ordering, measuring frequency of delivery, quality documentation, maintaining claims procedures, order completeness, providing technical support and checking order status information.

Collaborative networks and value propositions: The type of value created and obtained by a specific collaboration is dependent on the degree of maturity of that collaboration (Bititci et al., 2004). Similarly, Childerhouse et al. (2003) propose a framework to describe the maturity of the collaboration in five stages. The five stages of maturities are: ad hoc, defined, linked, integrated and extended.

Furthermore, Bititci et al. mention that Childerhouse et al suggest ad hoc collaboration does not go beyond the traditional customer supplier relationship. However, "defined and linked collaboration focuses on operational issues and limited to collaborative planning, forecasting and replenishment of materials and capacities, i.e. Supply Chain Management" (p. 259). Moreover, the integrated and extended strategic level coordinates together and leads to strategic synergy. This can be characterized as extended and virtual enterprises. Therefore, the combined competencies of the parties in the supply chain affect and shape the value proposition of typical collaborative networks.

Moreover, Bititci et al., (2004) describe that supply chain is about collaborative planning, fulfillment and replenishment. However, they argued that supply chain "do not achieve the level of strategic collaboration and synergy along the supply chain" (p. 260)

Therefore, Bititci et al., (2004) develop a value proposition (VP) model in the supply chains. The model is shown as follows:

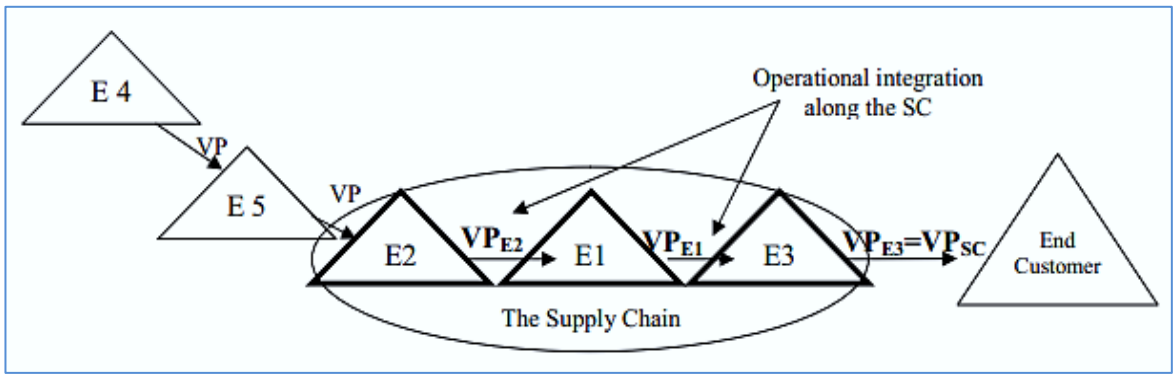


Figure 15: Value propositions in supply chains (Bititci et al., 2004, p. 262).

This figure explains value propositions that arise from the collaborations of the parties in the supply chain. This collaboration works when the companies in the supply chain contribute to their individual value proposition and then bring into line to the next member

of the supply chain. The value proposition of the overall supply chain is the same as that of the company that is facing the end customer, E3, in figure 15. The value proposition is the function (f) of the competences and capabilities of that last company in the chain. They developed the collaboration network relationship by the following constructs, which explains the relationships of the companies in figure 15.

$$VP_{SC} = VP_{E3=} f(CC_{E3})$$

Where, VP_{SC} = Value proposition of the supply chain

VP_{E3} = Value proposition of Enterprise #3

CC_{E3} = Competencies and capabilities of Enterprise #3

In addition, figure 15 directs that in the value proposition the parties or the owners of waste management are engaged in an exchange relationship. Therefore, it can be argued that the ownership of waste management involves logistics and transactions activities. Hammervoll (2014) mentions that according to Williamson (1985), "a transaction occurs when a good or service is transferred across a technologically separable interface. One stage of activity terminates and another begins" (p. 7). In addition, Hammervoll (2014) also mentions that this attributes can be characterized as exchange economy.

Consequently, based on the argument created by Hammervoll (2014) the transaction process of waste can be seen as exchange economy and the logistics of waste, where the (waste) raw materials used for further production transferred from one owner to another, can be seen as production economy. Therefore, the logistics process along with the exchange attributes creates customer value.

Summary: The term customer value in waste management is barely mentioned in previous literatures. Moreover, the relationship between the parties in the waste flow is not clearly defined and explained. In addition, the author reviews a numbers of waste management journals and literatures, but they could barely describe a clear and explicit relationship of parties in the value creation network of waste flow indicating who are the customers and how value is created for them. All the reviewed literatures mainly focused on products flow in the supply chain and the value of the end customer. In addition, previous literatures

mention the value creation from waste for example, environmental value, reuse, recycle, recover etc. However, the contribution of the parties itself help to create value in the waste supply chain.

Therefore, one of the original contributions of this paper is to clarify the relationships of parties in the waste flow and internal and external customer value created form waste management. The above-mentioned concept 'customer value' is also integrated into the waste management process. Chapter 5 describes that waste is a raw material in the reverse resource management flow. And, how the collaborative network creates value form the flow of waste (raw materials), simply, among the parties of waste flow 'who gets what' and how they create value in a collaborative network.

2.6 Summary/issues

This section summarizes all the important issues found, including gaps in the literatures. These issues can be considered as the 'research issues' and based on this issues new definition and value creation model of waste is developed. This is presented in the analysis chapter, after compiling the empirical data. These issues along with the empirical case description help to develop a new understanding that 'waste in not waste', rather it is a resource in the reverse flow of SCM.

Waste management is considered as the last stage of the material chain. The EC waste directive (2008) defines a material is a product when it is in the prevention stage. A return material, in the reuse, recycle, recovery and landfilling stage, is considered as waste. The definition of waste, according to this directive, indicates that an object is a waste, when the holder intends to discard and it cannot fulfill its original function. However, a number of literatures mention that waste creates value in every stage of its transformation process. Each party, each time, handles the waste, creates some monetary and/or non-monetary value. Thus, it can be argued that waste is something valuable because it creates value. Therefore, the first purpose is, if the return materials create value, why are they considered as waste? Therefore, this paper re-defines waste.

Similarly, reviewing the waste management literatures it is clear that there are waste producer, waste handler, and customer, who are engaged in the waste management

process. The waste producer is considered as the waste supplier. After proper processing, when this waste is used to create something valuable, it is sold to customers. Then, the second purpose can be raised, why not these waste materials are considered as the raw materials in the reverse flow of resource management process? Therefore, this study develops a new waste management framework.

Likewise, the reverse logistics literatures mention that reverse logistics is heavily integrated in the waste management process. A significant part of the assets of the waste management companies are invested on logistics of waste. Thus, logistics performance has a great impact on the profitability of the waste management process. However, this vital point has barely emphasized in the existing literatures. Therefore, another purpose of this paper is, to develop an understanding of how well reverse logistics is integrated into the waste management process, and influences the profitability of waste management.

Finally, reviewing the value creation literatures it is clear that waste creates value in the waste management process. Most of literatures and EC waste directive discussed about the value creation aspects of waste through reusing, recycling and recovery. However, the existing literatures hardly classified the relationships among the parties in waste flow. If this waste can be considered as ‘raw materials’ in the reverse resource management process, then it is important to clarify the supply flow of waste, and the relationships of the actors, from supplier to customer (internal and external). Thus, the foremost purpose of this paper is, to clarify waste management in network where the parties are involved in the waste flow based on the value proposition in the SCM perspective. Therefore, it leads to the development of a value creation model in waste management process.

3.0 Chapter Three: Research Methodology

3.1 Introduction

This chapter describes the methodology of the paper. The research design is explained, followed by a description of the case study type, case selection, types of data and methods for data collection. This study is a case study followed by a theory building approach from case. There is a summary of the methodology, which gives an indication that considering what issues new definition and theory of WM is developed in the empirical analysis and discussion.

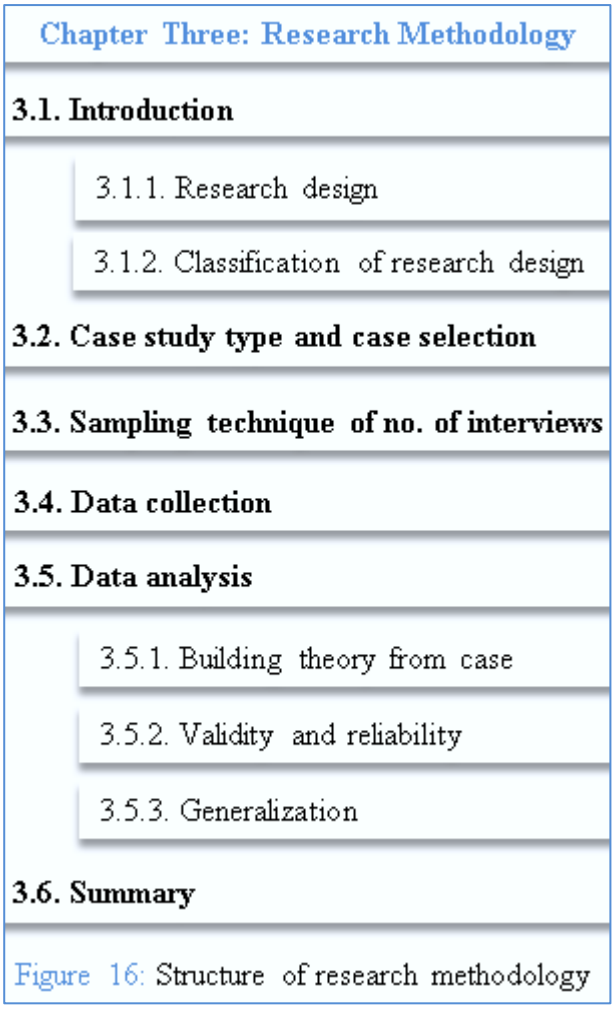


Figure 16: Structure of research methodology

3.1.1 Research design

Research design is defined by Yin (2009) as, "a logical plan for getting from here to there, where here may be designed as the initial set of questions to be answered, and there is some set of conclusions (answers) about these questions" (p. 26). The basic purpose of a research design is to find evidences that support the initial research questions. In other words, the purpose of using research design is to avoid a situation where the evidences do not address the initial research questions.

According to Yin (2009), there are five main components of research design that are used in this paper. They are:

Study questions: Study questions indicate what type of research that should be used in the study. The main goal is to describe the study questions and their purpose. Relevant

research strategy questions starts with, who, what, and where query. Similarly, the typical case study questions start with how and why query.

Similarly, the research problem of this paper focuses on areas relation to Vestbase's waste, where value is created and the areas of improvement, where higher value can be created. To reach this research goal the first and third research questions start with what question. The second and fourth research questions start with how question. Therefore, the research problem is related to the study questions and they are relevant for this paper.

Study propositions: A study proposition is an addition to the study questions and the formulation of it helps deciding where to start the research. However, Baxter and Jack (2008) argue that because of researchers lack of experience, knowledge or information, proposition cannot be presented in an exploratory case study.

However, the proposition in this study is to build theory in the value creation network among the companies at Vestbase. Therefore, the study proposition is related to the research design and relevant for this paper.

Unit of analysis: An important feature of research design is choosing the unit of analysis. The unit of analysis can be a company, an individual person, an event or an entity (Yin, 2009). Similarly, case studies have also been done about decisions, programs, the implementation process, and organizational change.

Correspondingly, in this study, unit of analysis is waste. According to Voss et al., (2002), there is no clear definition of what is a single case or unit of analysis. Single case sometimes involve to the study of several contexts within the case (Mukherjee et al., 2000). This may indicate several units of analysis when the study potentially expands into several interlinked sub-cases.

In the same way, 'waste materials' represents the unit of analysis and WM process, business relationships, and network or chain are contexts. This is indicated in the research questions where understanding the technical features of waste is fundamental in this research. This is the form of 'bottom-up' inquiry where understanding operations is expected to provide insight into how to manage logistics resources and activities.

Linking data to propositions and criteria for interpreting the findings: This is done using tools and techniques on how to analyze the data. Yin (2009) mentions there are several ways to link the data to propositions: pattern matching, explanation building, time-series analysis, logic models and cross-case synthesis.

Accordingly, in this study the technique, to link the data to propositions, is a logical model. After analyzing the data there is a logical model presented to show the value creation model among companies. Therefore, the design to link the data to the propositions is relevant for this paper.

Criteria for interpreting findings: One way of interpreting the findings are using statistical data. It can also be done comparing other explanations of previous research in similar studies. However, sometimes these techniques might not support current explanation for the desired result.

Likewise, in this study, reviewing literatures and theories like EC waste management theory, the ownership concept of waste management and value proposition theory helped to create new understanding or research issues, which are mentioned at the end of the preceding chapter. These research issues are utilized in an analysis in an empirical case study of a WM network.

3.1.2 Classification of research design

According to Ellram (1996), research methodologies can be classified as, "according to the type of data used and the type of analysis performed on the data" (p. 96). The type of data can be divided into two categories, either empirical or modelled. Empirical data is often gathered for analysis from the real world, often via case studies and surveys. The data can also be modelled, where either hypothetical or real world data is manipulated by a model (Ellram, 1996). The following figure shows classification of research methodologies based on the type of data and type of analysis:

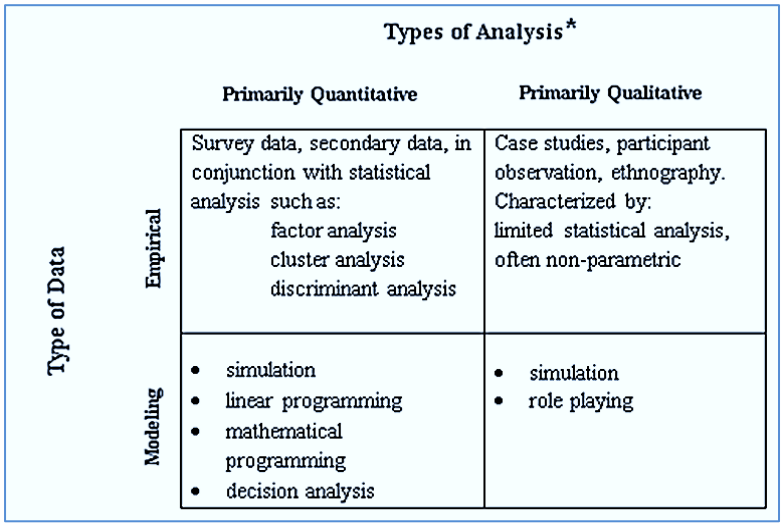


Figure 17: Basic research design (Ellram, 1996, p. 96).

Likewise, this thesis uses a case study method together with theory building approach. How this thesis fits well in a case study is described in the following next two paragraphs. The theory building approach is described in the data analysis section.

Case study as a research method: Using case studies as a research method remains one of the most challenging social science endeavors (Yin, 2009). Yin poses a question, "how do I know if I should use the case study method? (p. 4)". He suggests that there is no formula to understand that whether one should use case study method. However, the choice depends on the research questions at a great extent. The more the research questions seek to explain the contemporary circumstances; how and why this particular social phenomenon works; the more the case study method is relevant.

Similarly, this study is a case study. The choice of the research questions seek to explain some contemporary circumstances of an empirical problem. This study seeks to describe the WM system and value creation at Vestbase based on how and why questions. The research questions are set on how wastes are managed at Vestbase, create value in the waste flow and the flow related to RL. Subsequently, analyzing the value creation areas one important question is posed, why these waste materials are considered as waste when they create value. Consequently, based on the findings there are new initiatives to redefine waste, WM, and relationships between the parties in waste flow. Therefore, it can be argued that this study well fits as a case study research method.

Strengths of case study: Case study research has several advantages. According to Voss et al. (2002), unrestrained by the rigid limits of questionnaires and models, a case study can lead to new and creative insights. The authors suggest that it can help to develop new theory with high validity. In addition, a case study not only enriches the theory, but also the researchers themselves. In a case study a particular aspect is naturally studied. A relevant theory can be created from the gained understanding through observing the actual practice.

Moreover, the 'why' type question gives better understandings of the nature and complexity of the complete aspect (Meredith, 1998). According to Yin (2009), the examination of a case research data is most often conducted within the context of it use. It means within the situation in which the activity takes place (Zaidah, 2007). Besides, the thorough qualitative explanations frequently produced in case studies not only help to explore the context in real-life environment, but also help to clarify the complexities.

Weaknesses of case study: In contrary, there are several challenges in conducting a case study research. According to Voss et al. (2002), case research is time consuming, it needs skilled interviewers. Moreover, intensive care is needed to draw generalizable conclusion in ensuring rigorous research. Direct observation is used to conduct case research.

Furthermore, direct observation needs access to phenomenon being studied which is time consuming. The need for multiple methods and tools are both costly and time consuming (Meredith, 1998). According to Eisenhardt (1989) building theory from case has weakness for example; the intensive use of empirical evidence can produce overly complex theory. In the same way, a case study can produce a theory, which is rich in detail, but lacks the simplicity of overall perspectives.

3.2 Case study type and case selection

There are several categories of case studies exist in different literatures. Yin (2009) mentions three categories of case studies namely, exploratory, descriptive and explanatory. The author further distinguishes among single, holistic and multiple-case studies. Stake (1995) categorizes case studies as intrinsic, instrumental, or collective. McDonough and McDonough (1997) categorizes case study as interpretive and evaluative.

Exploratory case study: An exploratory case study explores a phenomenon through the data, which serves as a point of interest of the researcher (Zaidah, 2007). According to Yin (2009) exploratory case study is conducted to those situation where the phenomenon is evaluated has no clear, single set of outcomes. One of the advantages of exploratory case study is it narrows down the scope of investigation. On the other hand, it is usually costly and if the results come out negative means nothing found.

Descriptive case study: This type of case study is used to describe a phenomenon which occurs within the data in question (Yin, 2009). Descriptive studies can be in a narrative form (McDonough and McDonough, 1997). One of the challenges of a descriptive study is that the researcher must follow a descriptive theory to support the description of the phenomenon.

Explanatory case study: According to Yin (2009) this type of case study is used to answer a question that requires clarification of the real life environment, which is complex for survey or experimental research. An explanatory case study can examine the data closely both at a surface and a deep level in order to describe the story in the data (Zaidah, 2007).

Correspondingly, the objective of this study is to describe Vestbase's WM network where value is created and areas of improvement where higher value cane be created. Initially, it seems a descriptive case study but this study explores a phenomenon (Vestbase's waste flow) through the data, which serves as a point of interest of the researcher. In addition to this, this study is conducted to the situation where the phenomenon (value creation from waste) is evaluated has no clear, single set of outcomes. Therefore, this study is an exploratory case study.

Case selection: Case studies can be single or multiple. Yin (2009) divides case studies into four categories: single-case with holistic designs, single-case with embedded designs, multiple-case with holistic designs, and multiple-case with embedded designs. The following figure shows the classification of case:

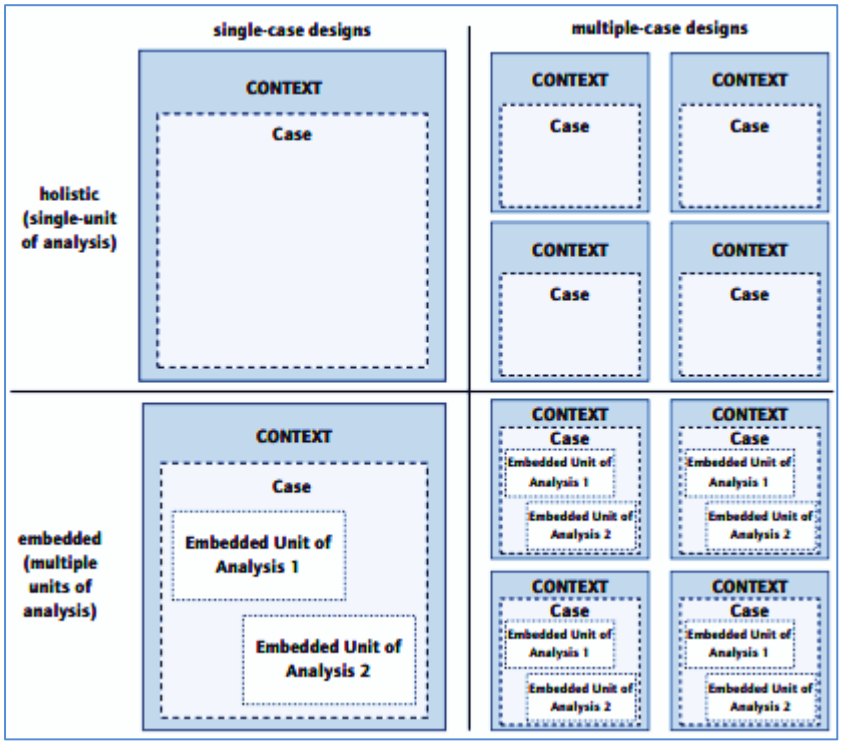


Figure 18: Basic types of design for case studies (Yin, 2009, p. 46).

This figure suggests that single case can deal with either single or multiple unit of analysis. Single case with one unit of analysis is called holistic single case study design. Single case with multiple unit of analysis is called the single embedded case study design. Multiple case study design deals with multiple cases with either single unit of multiple unit of analysis. However, Voss et al., (2002) argue that there is no clear definition of what is a single case or unit of analysis. Moreover, Single case sometimes involves to the study of several contexts within the case (Mukherjee et al., 2000). This may indicate several units of analysis as the study potentially expands into several interlinked sub-cases.

Accordingly, this study is a single case study design with one unit of analysis. The case is all about Vestbase (including all the companies located on Vestbase) and the entire business park considered as a single case. The unit of analysis is ‘waste’. Therefore, initially it seems like this study is a ‘single holistic case study design’. However, there are several contexts in this case for example, WM process at Vestbase, business relationships among parties, and network or chain of waste flow. Therefore, single case, along with one unit of analysis and several contexts make this case as an ‘embedded single case study design’.

3.3 Sampling technique of no. of respondents or interviews

Unlike quantitative study, there is no particular sampling formula or technique for qualitative study. It is an important question, to design a case research, what should be the number of respondents? Different researchers have different opinions in this matter. However, researchers have similar opinions that it depends on the nature of the research. There are some viewpoints regarding sampling of respondents presented by Simon and Goes (2011).

For case study research, along with other types of data, 3-5 respondents can be used (Creswell, 2002). In phenomenological studies, the recommended sample size ranges from 6 (Morse & Chung, 2003) to 10 (Creswell, 2002). Furthermore, in grounded theory research, the recommended sample size ranges from 15-20 (Creswell, 2002) to 20-30 (Morse & Chung, 2003). In addition, for ethnographic research, sample size can be 30-50 (Morse & Chung, 2003); and collection of data up to the stage of data saturation.

Similarly, in this study data saturation strategy is applied as a sampling technique. A detail of data saturation is as follows:

Data saturation: Data saturation is the result of the completion of data collection and the corresponding sample size. After collecting enough data to determine the subjects, if the researcher decides to capture responses of some of next participants with the current data, the subject of the study is finished. It indicates that the researcher's concept represents the phenomenon of the research. Thus there is no need for further data collection.

Likewise, the sampling of respondents of this case study is formulated by data saturation strategy. A total of 10 different interviews are conducted. The interviews are conducted on several companies. After conducting 8 interviews, researcher applied data saturation strategy. The next 2 key informants were asked the similar questions and there was nothing new or no surprising answer came out. The answers are repetitive then and the researcher decided not to go for further data collection.

3.4 Data collection

The criteria of data collection processes should be guided by the research question (Christine, 2001). In data collection process selecting sources of evidence is important (Yin, 2009). There are six sources of evidence mentioned by Yin. Yin also suggests that after deciding the sources of evidence a researcher should follow three principles to collect data.

Sources of evidence: There are six sources of evidence (Yin, 2009): documentation, archival records, interviews, direct observation, participant-observation, and physical artifacts. Each source is related with any range of data. Yin suggests that no single source has a complete advantage over all others. The use of multiple sources are highly recommended, and a researcher should use as many as source as possible to conduct a good case study. Table 10 in Appendix C shows sources of evidence with corresponding strengths and weaknesses.

Principles of data collection: Yin (2009) suggests three principles of data collection: using multiple sources of evidence, creating a case study database, and maintaining a chain of evidence.

In addition, using multiple sources of evidence in a case study allows an investigator to address a broader range of historical and behavioral issues. The most important advantage of using multiple sources of evidence is the development of converging lines of inquiry, a process of triangulation and corroboration. Consequently, finding or conclusion of the case study is likely to more convincing and accurate if it is based on several different sources on information.

Likewise, in this study multiple sources of evidence are used. Current and previous documentation along with company archival records are collected from Vestbase. There are sufficient numbers of interviews conducted to develop a thick rich description of the case. Direct observation is used to observe activities at the base area. The details of the date collection are described in following sections.

3.4.1 Primary data

To maintain sources of evidence and principles to collect data, data collection can be divided into two categories. The data can either be primary or secondary. Hox and Boeije (2005) define primary data is, "data that are collected for a specific research problem at hand, using procedures that fit the research problem best" (p. 593). The following table:

	Solicited	*Spontaneous*
Quantitative	Experiment Interview survey Mail survey Structured diary Web survey	(Passive) observation Monitoring Administrative records (e.g., statistical records, databases, Internet archives)
Qualitative	Open interview Focus group Unstructured diary	(Participant) observation Existing records (e.g., ego-documents, images, sounds, news archives)

Figure 19: Primary data (Hox and Boeije, 2005, p. 593).

Similarly, the primary data collection in this research study is collected in several ways. In the beginning some informal conversations were performed with employees at Vestbase AS. This was related to the waste handling section of the logistics department in order to achieve an overview and a better understanding of the overall picture of WM at Vestbase. Several interviews were executed inside and outside the base.

Furthermore, besides interview there were several observations took place at the base area. These observations were fairly unstructured to get a better understanding of the waste handling, and took place in the company for a span of several weeks maintaining reasonable gap during the summer of 2013. The details of interview and observation are discussed in the interview and direct observation section

3.4.1.1 Interview

Interview is one of the useful methods of data collection. In case studies the interview used are normally more guided conversations than structured queries. It is important to ask questions in a manner that helps to gain the needed information. However, the questions should at the same time be reasonable and easy to answer for the interviewee. Yin (2009) mentions three types of interviews: open-ended, focus- and survey interviews.

In an *open ended interview*, the interviewer can ask about facts and interviewer's opinion about the subject of investigation. In addition to this, the interviewee may provide extra information to come up with propositions that may be basis for further exploration. From such an interview the interviewer may also get suggestions on other sources of information (Yin, 2009).

In a *focus interview*, can still be open ended, but follow a certain set of questions. Focused interviews have a shorter time span, like an hour. In focus interview the question might concern facts that the interviewer already knows, but need to confirm and underpin (Yin, 2009).

Survey interviews follow more structured pattern of data collection and survey-like questions. In a case study this type of interview is mainly used to collect quantitative data and analyzed as a regular survey (Yin, 2009).

Interview techniques: Ellram (1996) classifies the interview techniques into unstructured, semi-structured and structured interviews. Unstructured interviews are conversational, while structured interviews may be in the form of a questionnaire. Semi structured interview lies between these two, and the techniques used can be focus group interviews. However, Huston and Hobson (2008) define the basic form of focus group interview is, "meetings with a small group of individuals (i.e., informants or participants) that allow for the exchange of information, opinions, and feedback related to a single topic" (p. 189).

Strengths of interviews: In an interview the interview questions can be adjusted to target area according to what the researcher is investigating. During interview time the informant can make things more explanatory. This may contribute to increase transparency for the researcher. It is mentioned earlier, according to Yin (2009) the informant can also suggest additional sources and can give access to achieve that information.

Weaknesses of interviews: Several weaknesses can also be mentioned about interviews as a data collection method. If the interview questions are not well structured, the resulting information will not be as good as it could have been. In addition to this, the interviewee may provide inaccurate information due to poor recall. Furthermore, according to Yin

(2009) the interviewee may be affected by the interviewer and answer what the interviewer wants to hear.

However, there are 10 interviews are conducted for this study. All interviews are semi structured in a focus interview type. Focus interviews are prepared with a set of questions that were asked to the different informants to gain a step by step overview of the waste flow at the base. Each interview carried an average of 20 main questions. Each main question was further extended to several sub questions.

Furthermore, a single interview lasted long an average of 1 hour. Regarding some already known facts, the respondents were still asked questions according to the interview protocol in order to confirm information from different sides. The informants were given enough room for the interview object to come forward with their own insight information during the conversations.

Accordingly, during the interview time, some of the respondents provided extra information and made it more explanatory. In some cases respondents suggested additional sources of data which helped the author to collect supplementary information.

3.4.1.2 Direct observation

Direct observation is another useful way to collect data that provides additional information about the topic. According to (Yin, 2009) the reliability of the observations increases with the number of observers. There are strengths and weaknesses of direct observations. One advantage is that the situation is studied in real time. In addition to this, the observer can also cover the context of the case. However, direct observations may be time-consuming. Moreover, Yin (2009) argued that the situation may also be affected by the fact that it is being observed, and it may therefore proceed differently.

Correspondingly, in this study direct observations were followed some extent. Vestbase allowed the researcher to walk inside the base area and warehouse of Norsk Gjenvinning, which gave the researcher some opportunities to observe. Observations were made throughout the waste handling and recycling field visit in Vestbase and other companies on Vestbase, for instance in connection with the interview.

Moreover, the waste loading and unloading time, recycling process, type of transportation, environmental concern was observed throughout the companies on Vestbase. Observations of waste and waste processes in action at Vestbase were noted, photographs taken, and used to enrich the case description.

3.4.2 Secondary data

Secondary data is defined by Hox and Boeije (2005) as, "data originally collected for a different purpose and reused for another research question" (p. 593). There are some strengths and weaknesses associated with secondary data collection. Secondary data can be less time consuming to achieve and not costly. However, it can be difficult to find data that can be useful for this particular research. In addition to this, Hox and Boeije, (2005) argue that it is important to be able to evaluate the quality of the retrieved data.

Similarly, in case of qualitative data, for this study, several sources were used to obtain information. These sources include company websites from NorSea Group, Vestbase AS, Norske Shell, Maritime Waste Management, and Norsk Gjenvinning. Additional secondary material was received from different interviews. This was information on internal presentations of the company, job descriptions and visual images from selected pages in different information System.

Moreover, the quantitative data collected from the company were about the annual waste receiving records, what type of wastes, volumes, prices etc. The data originated from Vestbase AS and Norsk Gjenvinning records. In addition to this, a large part of the secondary data was collected and obtained by searching in relevant literature and recent academic journals, PhD and master thesis and different websites.

3.5 Data analysis

The data is analyzed based on the theory building approach form case study. The detail of the building theory from case is discussed in following section 3.6.1. Later, there are evidences to support the validity and reliability (section 3.5.2) and generalization (section 3.5.3) of the study.

3.5.1 Building theory from case

Unlike exploratory case study, grounded theory and other types of theory building approach, Eisenhardt (1989) claims that, "it appears that no one has explicitly examined when this theory-building approach is likely to be fruitful and what its strengths and weaknesses may be" (p. 532). Furthermore, a case study can be used to provide description of a situation (Kidder, 1982), test an existing theory (Pinfield, 1986; Anderson, 1983), or generate a new theory (Gersick, 1988; Harris and Sutton, 1986).

Likewise, this study seeks to create new theories in waste management process in relation with logistics for the purpose of value creation. To achieve this goal, the eight steps of the process of building theories from case study, developed by Eisenhardt (1989), is thoroughly followed. The steps are shown in the following figure:

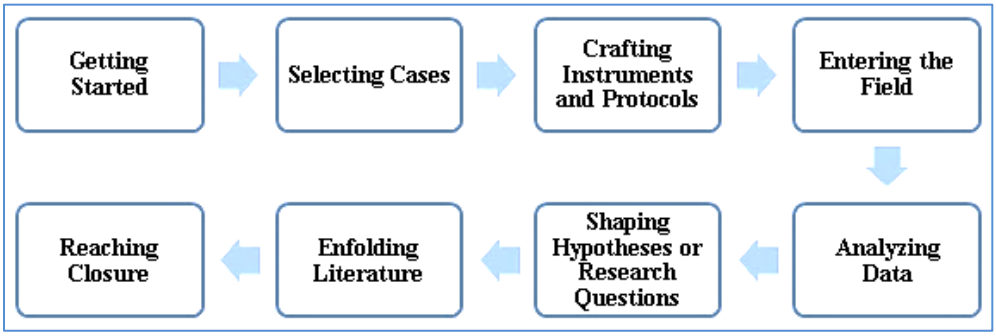


Figure 20: Process of building theory from case study research (modification of the original work of Eisenhardt, 1989, p. 533).

Getting start: Definitions of research questions are important for building theories from case studies. Mintzberg (1979) argues that, "No matter how small our sample or what our interest, we have always tried to go into organizations with a well-defined focus-to collect specific kinds of data systematically" (p. 585). The clear definitions of the research questions provide better grounding of construct measures.

Similarly, mentioned earlier that the research questions of this study are well defined. The research questions are set in a consistent manner and the solution of each question consistently contributes to explain other research questions. Therefore, it helps to reach the gradual understanding of the value creation aspect of waste management network of Vestbase.

Selecting cases: To build theory form case, the case should be selected based on neither a theory nor hypothesis. It can ensure theoretical flexibility.

Likewise, in this study the case is selected based on neither any particular theory nor hypothesis. The case is selected based on the real empirical phenomena. Once the case is selected the research questions are set to address the research problem and later the case is integrated into the potential existing theory to ease the empirical analysis.

Furthermore, the sampling of case is unusual when building theory from case studies. However, it is significant how many cases or company or units are studied to induce the findings.

In the same way, in this study several contexts may indicate several units of analysis as the study potentially expands into several interlinked sub-cases. Therefore, the selection of case and several contexts are presumed to suitable to build theory.

Crafting instruments and protocols: It emphasizes multiple data collection methods. The purpose of multiple data collection is to strengthen grounding of theory by triangulation of evidence. Eisenhardt (1989) mentions qualitative and quantitative data can be collected together.

Equally, it is mentioned in the data collection section that, qualitative and quantitative, data is collected using multiple methods and the data is triangulated suitably to strengthened grounding of theory. Therefore, the crafting instruments and protocols seem to be applicable.

Entering the field: The main activity in this stage is to overlap data collection and analysis including field notes. In addition, flexible and opportunistic data collection methods are recommended. This can ensure investigators to take advantage of emergent themes and unique case features.

Similarly, the data collection of this study is flexible where sufficient number of interviews and field observation and some of the data are overlapped to detect the depth of the contexts.

Analyzing data: The main activity recommended in this phase is within-case analysis. This can help to gain familiarity with data and preliminary theory generation.

Accordingly, in this study several contexts are considered as the sub cases. These sub cases are analyzed in a within-case analysis basis.

Shaping research questions: It indicates the replication of evidences, not sampling logic across cases. This confirms, extends, and sharpens theory. Furthermore, searching evidence for 'why' behind relationships can build internal validity.

In the same way, the research questions of this study are set in a manner that answer 'how' and 'why'queries. Therefore, the shaping of research question seems to be related to theory building.

Enfolding literature: The main activity at this point is to compare literatures on the basis of similarities and conflicting approach. The comparison with conflicting literatures builds internal validity, raises theoretical level, and sharpens construct definitions. The comparison with similar literatures sharpens generalizability, improves construct definition, and raises theoretical level.

Likewise, in this study there are sufficient numbers of literatures are reviewed some of which are conflicting and similar. Based on this similarities and conflicts among literatures there are research issues set in the summery of the literature review. Therefore, it indicates that the analysis of literatures is sufficient enough to build theory.

Reaching closure: The final stage emphasizes the possibility of theoretical saturation. It helps to ends the process when marginal improvement becomes small. Eisenhardt suggested that, "Two issues are important in reaching closure: when to stop adding cases, and when to stop iterating between theory and data" (p. 545).

Similarly, the data collection is stopped based on the data saturation strategy. The details are discussed in the preceding section. In the second case, the iteration process stops when the incremental improvement to theory is minimal.

Equally, the literature search is stopped when the gap between the theory and data is minimal. Therefore, the closure of building theory from this case study appears to be applicable.

3.5.2 Validity and reliability

A research design represents a logical set of statements. Therefore, Yin (2009) argues that, "you also can judge the quality of any given design according to certain logical tests" (p. 41). The following table shows the summarized tests, which indicates the criteria of measuring validity and reliability of a research.

TESTS	Case Study Tactic	Phase of research in which tactic occurs
Construct validity	• use multiple sources of evidence • establish chain of evidence • have key informants review draft case study report	data collection data collection composition
Internal validity	• do pattern matching • do explanation building • address rival explanations • use logic models	data analysis data analysis data analysis data analysis
External validity	• use theory in single-case studies • use replication logic in multiple-case studies	research design research design
Reliability	• use case study protocol • develop case study database	data collection data collection

Figure 21: Case study tactics to measure validity and reliability (Yin 2009, p. 41).

Construct validity: Construct validity refers to the observations or measurement tools actually represent or measure the construct being investigated. Yin (2009) mentions there are three tactics available to increase construct validity of a case study: multiple sources of evidence, chain of evidence and the draft case study report reviewed by key informants. Multiple sources indicate that case study evidence should come from many sources for example, documentation, archival records, interviews, direct observations, participant observation and physical artefacts. Chain of evidence indicates that the evidences follow

the derivation of any evidence from initial research question to ultimate case study conclusion.

Similarly, in the data collection section it is mentioned that multiple sources of evidences are used for collecting data. Moreover, the chain of evidence is maintained in every stage of analysis starting from the research question to the conclusion of the case. In addition, the draft case study report is reviewed by key informants before final submission. Therefore, it can be assured that the construct validly of this study is evident.

Internal validity: Yin (2009) mentions that internal validity is mainly for explanatory case study. However, in the data analysis explanation building and logical model can be developed in case of exploratory case study.

Likewise, in the analysis of this study there are new definitions and understandings developed, which indicate that the explanation is built properly. Furthermore, a logical model is also developed to describe the value creation network in the waste flow of Vestbase. Therefore, it can be argued that the internal validity of this study is relevant.

External validity: To ensure external validity, Yin proposes that in the research design of a single case study, theory should be used.

Similarly, in this study, waste management theory, ownership concept and value propositions are used to assist the case analysis. Thus, it ensures that the external validity is properly attained.

Reliability: The term 'reliability' is most often used in all kinds of research. Although mainly used for testing or evaluating quantitative research (Golafshani, 2003). The most important test of any qualitative study is its quality. According to Eisner (1991), a good qualitative study can help, "understand a situation that would otherwise be enigmatic or confusing" (p. 58). Golafshani mentions that according to Stenbacka (2001), "the concept of reliability is even misleading in qualitative research because if a qualitative study is discussed with reliability, as a criterion, the consequence is rather that the study is no good" (p. 552). Therefore, Lincoln and Guba (1985) argue that in qualitative research the

terms credibility, neutrality or conformability, dependability and transferability are to be the essential criteria to measure quality.

Moreover, Lincoln and Guba (1985) argue that, “since there can be no validity without reliability, a demonstration of validity is sufficient to establish the reliability" (p. 316). Therefore, Golafshani poses a question, “how to test or maximize the validity and as a result the reliability of a qualitative study?” (p. 602). Yin (2009) proposes that in data collection stage using case study protocol and developing case database can help to safeguard the reliability of the study.

Furthermore, a case study protocol is a major way of increasing the reliability of the case study research and is intended to guide the investigator to carry out the data collection from a single case. The table of a case study protocol proposed by Yin in mentioned in table 11, Appendix C. A case study database is the collection of evidence the researcher has collected during the research period. The database contains documents, data and other evidences. Yin (2009) emphasizes that the database should be formal and presentable, so that principle, other investigators can review the evidence directly and not be limited to the written case study report. Consequently, a case study database evidently increases the reliability of the entire case study.

In addition, stated earlier that the validity of this study is maintained properly to increase the acceptability of the research. Thus, well maintained validity increases the reliability of the study. Furthermore, the case study protocol mentioned in table 11, appendix C is followed appropriately. In addition, the case study database is well maintained in a formal and presentable way. All the interviews were recorded on spreadsheet for easy retrieval and analysis. Thus, other investigator can review the evidence directly without only relying on the written case study. Therefore, it can be argued that the reliability of this study is manifested.

3.5.3 Generalization

The term generalizability is defined by Polit and Hungler (1991), as, “the degree to which the findings can be generalized from the study sample to the entire population” (p. 645). According to Myers (2000) in spite of the opinion that qualitative studies are not

generalizable in the traditional sense, other positive features which makes them highly valuable to the readers. Similarly, Adelman et al. (1980) argue that the understanding generated by qualitative research is noteworthy in its own right. However, Stake (1980) claims that a single qualitative study is not an adequate basis for generalizations. Nevertheless, Stenbacka (2001) argues that credible and defensible result of the case study can lead to generalize the findings.

Moreover, Patton (2001) contends that generalizability is one of the criteria for quality case study, which depends on the case selection and analysis. In addition, Horsburgh (2003) claims that the generalizability in qualitative research refers to the extent to which the theory is developed within one study. Similarly, this idea shares the similar view with Popay et al. (1998). The authors argue that, "the aim is to make logical generalizations to a theoretical understanding of a similar class of phenomena rather than probabilistic generalizations to a population" (p. 348).

This study is a single case study, with the purpose, of developing theoretical understanding with logical generalizations. Moreover, this study focuses on theory building approach, which is consistent with the idea of Horsburgh (2003) and Popay et al. (1998) in generalizing the study. In addition, the case selection and analysis is technical, which gives the researcher to develop and analyze, like an in-depth study, which is steady with the idea of Patton (2001). Lastly, similar to Stenbacka's (2001) argument, the credible and defensible result of this case study may lead to generalize the findings.

3.6 Summary

This study is an exploratory case study to explore the real phenomena in WM process at Vestbase. The basic purpose is to explore the value creation areas in waste flow. It is a single embedded case study along with several contexts. The contexts are often embedded in a way that gives an impression that these contexts can be considered as sub-cases. The unit of analysis is 'waste' and this is the central of the discussion and the relation of waste with value leads to the development of new theories.

Moreover, the theory is built based on the theory building approach from the case study. The development of the research questions is happened to be quite technical that helps to

build the theory with new understanding of waste, in a way that waste is something valuable.

Furthermore, multiple sources of evidence are used to ensure construct validity. Logical model is developed thorough explanation building to safeguard internal validly. Furthermore, suitable theories are used along with replication strategy to maintain external validity. In addition, case study protocol and case study database are maintained to retain reliability of the study. As well as, the development of theoretical understanding, theory building approach with logical generalization along with credible and defensive result may help to generalize the findings.

4.0 Chapter Four: Empirical Case Description

4.1 Introduction

This chapter describes the case based on the empirical data collected from four selected companies (actors). A brief summary of the actors and their inter-connection in the value creation network from waste generation to value recovery is discussed. The data description helps to create basic understandings to solve the four research questions. Therefore, based on the empirical findings from this chapter, the four research issues are addressed and solved in the empirical analysis chapter.

Chapter Four: Empirical Case Description

4.1. Introduction

4.2. The actors

- 4.2.1. Norske Shell (Shell)
- 4.2.2. Vestbase
- 4.2.3. Maritime Waste Management
- 4.2.4. Norsk Gjenvinning (NG)

4.3. Case description

- 4.3.1. RQ 1: What are the types of wastes handled at Vestbase?
- 4.3.2. RQ2: How are these forms of waste managed?
- 4.3.3. RQ 3: What characterizes the RL processes of the types of waste managed through Vestbase?
- 4.3.4. RQ 4: How do these wastes, along with RL processes, create value in the WM network?

4.4. Summary

Figure 22: Structure of empirical case description

4.2 The actors

There are four actors considered for this case study. Vestbase is an industrial park and all these actors have businesses inside and outside the base. These actors are methodically selected to fulfill the research objective to create a new understanding of value from waste in the reverse logistical process. These actors are interconnected in the inter-organizational value network process. The process starts from waste generation, waste handling, and ends with value recovery. In the empirical data description, due to the privacy concern, the names of the respondents are not revealed. However, the responses from each respondent are presented under each company name.

4.2.1 Norske Shell (Shell)

Shell was established in Norway in October 1912 under Norwegian English Mineral oil Aktieselskap (Nemak) (Shell, 2013a). For 28 years they retained the name Nemak until January 1940 the name was changed to A/S Norwegian Shell (Shell, 2013a). Norwegian Shell has actively participated on the Norwegian continental shelf about 50 years ago and currently operates the Draugen and Ormen Lange (Shell, 2013b). The headquarters of Norwegian Shell exploration and production is located in Sola, Stavanger and the operating organization is in Kristiansund (Shell, 2013b).

Furthermore, Ormen Lange is one of the most complex and technically challenged operation fields operated by Norwegian Shell. The gas from the Ormen Lange covers up 20% of Britain's gas needs (Shell, 2013b). Draugen started production in 1993, located 150km north of Kristiansund and produces at most about 225,000 barrels of oil a day (Shell, 2013c). Along with Statoil ASA, Norske Shell is the main offshore waste producer at Vestbase (Shell, 2013d). Based on the latest record only Shell's Transocean Barents produced 2769 tons of wastes from January to July, 2013 (Vestbase, 2013b). The recent wastes generation records including industrial waste, metal waste, and hazardous wastes are shown in appendix A in chart 1, 2, 3 and 4 respectively.

4.2.2 Vestbase

In early 1970s an oil committee was appointed by the Norwegian government to place Kristiansund on the map relevant for the oil business (Vestbase, 2013c). In 1975, Kristiansund was selected by the National Assembly as the main service base for oil exploration in the North Sea. In 1978, the Municipality of Kristiansund and Statoil ASA entered into a joint venture agreement to build the supply and service base, Vestbase (Vestbase, 2013c). The first construction stage on the base was finished in 1980 and the first operator was Saga Petroleum AS, with the drilling rig Borgny Dolphin (Vestbase, 2013c).

In addition, Vestbase is 100% owned by NorSea Group AS (Vestbase, 2013c). NorSea Group is the leading supplier of integrated logistics system and base services to the Norwegian oil and gas industry. Vestbase has various important milestones as a supply base. Many fields operated by Statoil and Norske Shell get their supplies from Vestbase.

Vestbase provides base facilities to Heidrun platform, Njord, platform, Åsgard A ship type rig, Åsgard B platform, Mikkel sub-sea field, Kristin platform, Yttergryta sub-sea field, Tyrihans sub-sea field, and Morvin sub-sea field operated by Statoil ASA (Vestbase, 2013c). In addition to this, Vestbase also supplies to Draugen and Ormen Lange sub-sea field operated by Norske Shell.

Moreover, tons of wastes are produced from these oil platforms every year and shipped to Vestbase for further handling. Vestbase receives these waste materials and handle them through WM companies established at the base (Vestbase, 2013d). A general overview of amount and types of wastes handled at Vestbase is shown in Appendix A in chart 1, 2, 3 and 4 correspondingly.

4.2.3 Maritime Waste Management (MWM)

MWM AS was founded in 2004. The company is 50% owned by NorSea Group AS and 50% by Coast Center Base AS (MWM, 2013a). MWM offers waste services at all bases in Norway. MWM offers services in three business areas namely shipping, oil and gas, and projects consulting. MWM controls and co-ordinates waste flows generated by oil and gas companies and other industrial customer both on and offshore (MWM, 2013b).

Also, the company offers services in general waste handling, coordination of subcontractors, intermediate storage, transportation, container rental, balers and sorting equipment. The company is an independent and technology oriented waste contractor and does not hold assets within the waste treatment industry. This strategy helps MWM to provide services with Best Environmental Practices (BEP) at Best Available Techniques (BAT).

Moreover, at Vestbase MWM works along with Norsk Gjenvinning to handle, manage and transport of offshore waste generated by oil companies (MWM, 2013c). In addition to this, MWM collects, handle and process all the general industrial waste generated by onshore companies at the base area.

4.2.4 Norsk Gjenvinning (NG)

Norsk Gjenvinning (NG) (Norwegian Recycling Group) started as a small scrap trade in 1926 (Norsk Gjenvinning, 2013b). NG Group is Norway's leading environmental service provider. NG offers a wide range of sustainable WM and recycling solutions, working with businesses, industry and local authorities across the country (Norsk Gjenvinning, 2013a). NG works across four main areas to recover raw materials and preserve natural resources. The main areas are: waste and recycling services; industrial services, hazardous waste and offshore services; ferrous and non-ferrous metal recycling; and demolition (Norsk Gjenvinning, 2013a). In addition to this, NG works as a trader of secondary raw materials.

Furthermore, in the waste and recycling fraction NG is Norway's leading waste and recycling specialists, providing innovative, practical and environmentally sound services (Norsk Gjenvinning, 2013a). NG collects 1,700,000 tons of wastes per year from 90 different locations and has revenue of 4 billion NOK (Norsk Gjenvinning, 2013a). The fraction of Industrial services, hazardous waste and offshore services NG provides efficient, sustainable site services and hazardous waste collection and treatment for industrial clients, as well as bespoke tailored solutions for the offshore market (Norsk Gjenvinning, 2013a).

In addition, based on the data; collected through the interview and field observation; at Vestbase, NG collects, sort and handle wastes from on and offshore wastes producers (Norsk Gjenvinning, 2013c). NG has its own warehouse and waste water reclining plant at the base area. NG receives, sorts and stores them for a short time until the volume is enough to ship downstream parties. In the reclining plant, NG recycles the contaminated water and releases to the sea. After all NG plays an important role in Vestbase's WM and network of inter-company value creation process.

4.3 Case description

Heretofore mentioned that the case is described answering the four research questions based on the empirical data. The questions are answered in a consistent manner from waste generation to value creation from waste.

4.3.1 RQ1. What are the types of waste handled at Vestbase?

This section lists and shortly describes the wastes handled at Vestbase based on the recorded interview. All respondents were asked similar questions to know the types of wastes handled at the base. This is a very general question and all the respondents provided same answers. In addition, the respondents provided the wastes record sheet, which includes all the wastes. However, one unique reply from all the respondents is:

> *"We mainly handle four fractions of wastes, they are: industrial waste, bulk waste, metal waste, and hazardous waste. The classification of wastes are divided into many fractions such as oil waste, sandblast, contaminated drain water, organic waste, cardboard, soft plastic, hard plastic... [ ] and so on"*

The detail lists of wastes are described below:

Industrial waste: Industrial waste is generated by offshore and onshore manufacturing or industrial processes, which do not include hazardous waste. The industrial wastes are divided into following categories.

Wet organic waste: This is basically food waste and consists of biological leftovers after meals. It also includes leftovers from fruits, vegetables, and other food related waste.

Combustible or food contaminated waste: This type of waste consists of the leftovers of everyday life associated with food, other than wet organic waste. This type of waste includes ice cream cover, yoghurt cup, plastic cutlery, plastic plates and cups, shaving blades, tooth brushes, tooth paste, box of match and cigarette, cloths, plastic slides, and other sanitary equipment.

Paper: Paper waste contains office papers, envelops, newspaper and magazines. This type of waste does not include brown paper.

Cardboard (brown paper): This includes waste from ridged cardboard and brown paper.

Soft plastic: This type of waste includes flexible plastic for packaging and shrinking foil. The plastic for packaging and shrinking foil must be clean. It also includes clean plastic caps, carrying bags, and bubble plastic etc.

Hard plastic: This waste includes clean but empty plastic cans, plastic bottles, and shampoo bottles etc.

Wood: Wood waste includes wood cases, one time use pallets, and destroyed pallets etc.

Glass: The glass waste includes drinking glasses, glass bottles, and cleaned jam glasses. These glasses can be of any color.

EE-waste: This type of waste includes all electrical and electronic equipment. It includes pumps, white goods, low current goods, calculators, switch cabinets, telephones, lighting fixtures, communication equipment, electrical engines, personal computer, heat and ventilation equipment, and printers etc.

Medical waste: Medical waste includes blood-soaked bandages, discarded needles, culture dishes, bedding, dressings, sponges etc.

General waste: These wastes are neither liquid nor hazardous wastes. These wastes contain different materials, but do not contain dangerous waste, contaminated waste or waste that belongs to any of the abovementioned categories. Examples of general wastes are packaging waste, dirt or rubble and general cleanup around the base. It also includes hydraulic hoses without oil, composite plastic from PVC, carpets or other materials used on floors, isolation and building mixed materials, ropes, rubber hoses and porcelain etc.

Homogeneous general waste: These wastes are general wastes. Examples of homogeneous general wastes are the same as general wastes, but the only difference is homogeneity. In addition to the above mentioned general wastes, homogeneous general waste also includes cable reels, milling shavings, and sand blowing etc.

Mixed (non-conformance): This type of waste has no specific materials. Some unspecified waste mostly in small volume is mixed from the offshore platform.

Bulk waste: Bulk waste is the technical term in WM that indicates waste in too large volume. This type of waste includes the following category.

Drain water: Drain water is polluted water generates from the oil platform. Drain water is accumulated where crude oil is pumped. This water is polluted and cannot be discharged into the sea without appropriate recycling process.

Metal waste: This type of waste includes heavy metal, light metal, and tiny wire or cables etc. These metal wastes are divided into five different categories. They are:

Metal: This fraction consists of fully empty painting cans, clean tin boxes for soft drinks and other similar category, steel, nickel, aluminum, waste iron, and sink etc.

Wire: The wire uses to bear mechanical loads, to carry electricity and telecommunications signals. It includes hook-up wire for example, small-to-medium gauge, solid or standard, and insulated wire etc., magnet wire for example copper, speaker wire, and resistance wire.

Empty barrels: It includes all types of empty barrels, which contain dangerous materials like liquid and solid materials that can cause fire, oxidizing, becoming poisonous or corrosion.

Miscellaneous noble metals: This fraction includes the metals that are resistant to corrosion and oxidation in moist air for example, ruthenium, rhodium, silver, osmium, palladium, iridium, platinum, and gold.

Cable waste: This fraction comprises of electrical cables, cables for electromagnetic fields, fire protection, and construction etc. It includes used or damaged ribbon cable, coaxial cable, twinax cable, flexible cable, non-metallic sheathed cable, metallic sheathed cable, multicore cable, shielded cable, twisted pair, twisting cable, helix cable, direct-buried cable, and heavy-lift cable.

Hazardous waste: Hazardous waste includes the waste that postures possible dangers to community and the environment. The characteristics of this type of waste are ignitability, reactivity, corrosivity, and toxicity. The offshore oil industry uses various hazardous

goods. The concern of this paper is to analyze the return of such goods, mainly treated as waste. The following types of hazardous wastes are handled at Vestbase. They are:

Batteries: It comprises of all types small and big re-chargeable and non-re-chargeable batteries. Smaller normal batteries labeled with green environment icon on the shell, treated as ordinary waste. All types of lithium air, lithium-ion, lithium iron, lithium-sulfur, lithium-titanate batteries are sorted separately.

Sandblast waste: This fraction includes waste originates from sandblasting. Sandblasting bestows sand and other chemicals at a high velocity to clean or etch a surface. Since most of the offshore machines and equipment paint contains heavy metals, such as lead, chromium and barium, sandblast waste is potentially harmful for humans and the environment.

Fluorescent waste: The fluorescent unused or ready to use goods have hazardous contents because it needs emission mix on the tube to enables electrons to pass into the gas via thermionic emission. The emission mix typically made of barium, strontium and calcium oxides. It also includes phosphor and mercury. This waste comprises of all types of fluorescent tubes, UV lamps, and saving bulbs.

Paint: Paint waste includes all types of liquid paint and unhardened paint. Unhardened paint waste covers all types of paint boxes, which have some remains of paint. It also includes some painting equipment such as paint brushes, paint rags, and spoiled cloth with paint.

Oil contaminated material: Oil contaminated materials are such waste from which used oil is accurately drained or removed. This process is completed in such a way that there is no visible sign of free-flowing oil in or on the material. This type of waste includes oil littered rags, cloths and absorbents, and small bottles containing oil.

Spray cans/aerosols: It includes all types of spray boxes and aerosols for example; air gun spray cans, HVLP cans, LVLP cans, hot spray cans, air assisted and airless spray or aerosol cans.

Drilling waste: Drilling waste can be divided into equipment wastes; chemical, fluid, and mud wastes; maintenance wastes, and personnel wastes. Some of these wastes are already discussed in the abovementioned waste categories. Equipment waste comprises of oil filters, lubricant oils, and fuel spillage. Chemical waste consists of extracts of drilling muds, acidic waste, and perforation waste. Fluid waste comprises of salt and fresh water. Mud waste includes drilling muds. Maintenance waste includes chemicals, solvents, and paints. Personnel waste generates from sewage and routine garbage.

Chemical mixture without halogen: This fraction includes mixtures of various chemicals without halogen (fluorine, bromine, neon, krypton, and chlorine etc.).

Chemical mixture with halogen: This type of waste comprises of mixtures of various chemicals with halogens (fluorine, bromine, neon, krypton, and chlorine etc.).

Chemical mixture without heavy metal: It consists of mixtures of various chemicals without heavy metal (lead, mercury, cadmium etc.).

Chemical (pure product) without halogen; and heavy metal: This waste includes pure chemicals remains after use, which has no existence of halogen (fluorine, bromine, neon, krypton, and chlorine etc.) and heavy metal (lead, mercury, cadmium etc.).

Chemical (pure product) with halogen: It comprises of pure chemicals remains after use, which has existence of halogen (fluorine, bromine, neon, krypton, and chlorine etc.) into it.

Chemical (pure product) with heavy metal: It consists of pure chemicals remains after use, which has existence of heavy metal (lead, mercury, cadmium etc.).

4.3.2 RQ2: How are these forms of waste managed?

Like the first section, this section too, first, introduces the respondent's view regarding waste management. Later, it discusses the waste management process at Vestbase based on the replies of the respondents which is shown in the figure 17. Regarding the management system of waste the respondents were asked several questions. Some of the questions are:

- How is the waste materials handled at your company?
- If these wastes are handled by other company, what is the business relationship?
- What are the challenges or obstacles handling waste?
- What is your suggestion to overcome those problems you mentioned? And so on.

Respondents answered all the questions with the profound explanations and insights of the waste management scenario. The respondents of Vestbase replied following ways:

- "We do not process any waste".
- "We have contracts with WM companies located on our base; they are responsible for the waste collection and treatment".
- "We just provide the handling and technical facilities on the base".
- "We also provide crane facilities to unload the waste from ships".
- "We do not face many obstacles except technical service because all wastes are processed by waste management companies".

The responses from the respondents of Shell are as follows:

- "We do not process or treat any waste on our own".
- "We have contracts with companies, for example, NG, to further treatment or processing of waste".
- "There are challenges to audit, inspect, and influence all the waste contractors to safe and environmental friendly treatment of waste".
- "If the waste management company or any other downstream parties cannot do their job properly, it is a matter to Shell because it's all about our good will and reputation".

The respondents of Norsk Gjenvinning (NG) replied in the following ways:

- "We collect all the waste generated by Shell at the base"
- "We do not treat all the waste at the base on our own; at the base we only have recycling plant where we recycle drain water"
- "We have downstream parties in the waste management network, who recover energy and after that landfill some of the wastes"
- "We also send some wastes out of Norway because of Governmental regulation"
- "We have certain responsibility to ensure safe treatment of waste, even something goes wrong in the downstream solutions we have responsibility to look after it".

- “It is not possible for us to check each and every ingredient into a small bottle of waste because we do not have enough facility at the base. We just trust our waste producer that the way they provide information in the decoration paper along with wastes”.
- “If we can have all the facilities to examine all ingredients at the base we can save more money. However, it is a costly matter to set up everything here at the base”.

The responses from the respondents of Maritime Waste Management (MWM) are as follows:

- “We collect all the general waste at the base”
- “We basically focus on management service and we do not process any waste at the base on our own”.
- “We have contract with downstream parties to further processing and recovering energy from waste”

Therefore, the whole scenario can be summarized that Vestbase receives wastes from offshore oil companies (waste producers/suppliers). These wastes are shipped to the base by ships which can be considered a reverse logistical activity. There are several downstream parties involve in the entire WM process. This section discusses only the handling part of waste at Vestbase in cooperation with Norsk Gjenvinning because Norsk Gjenvinning handles and processes all the offshore wastes. The waste handling and management process at Vestbase happen in in the following stages.

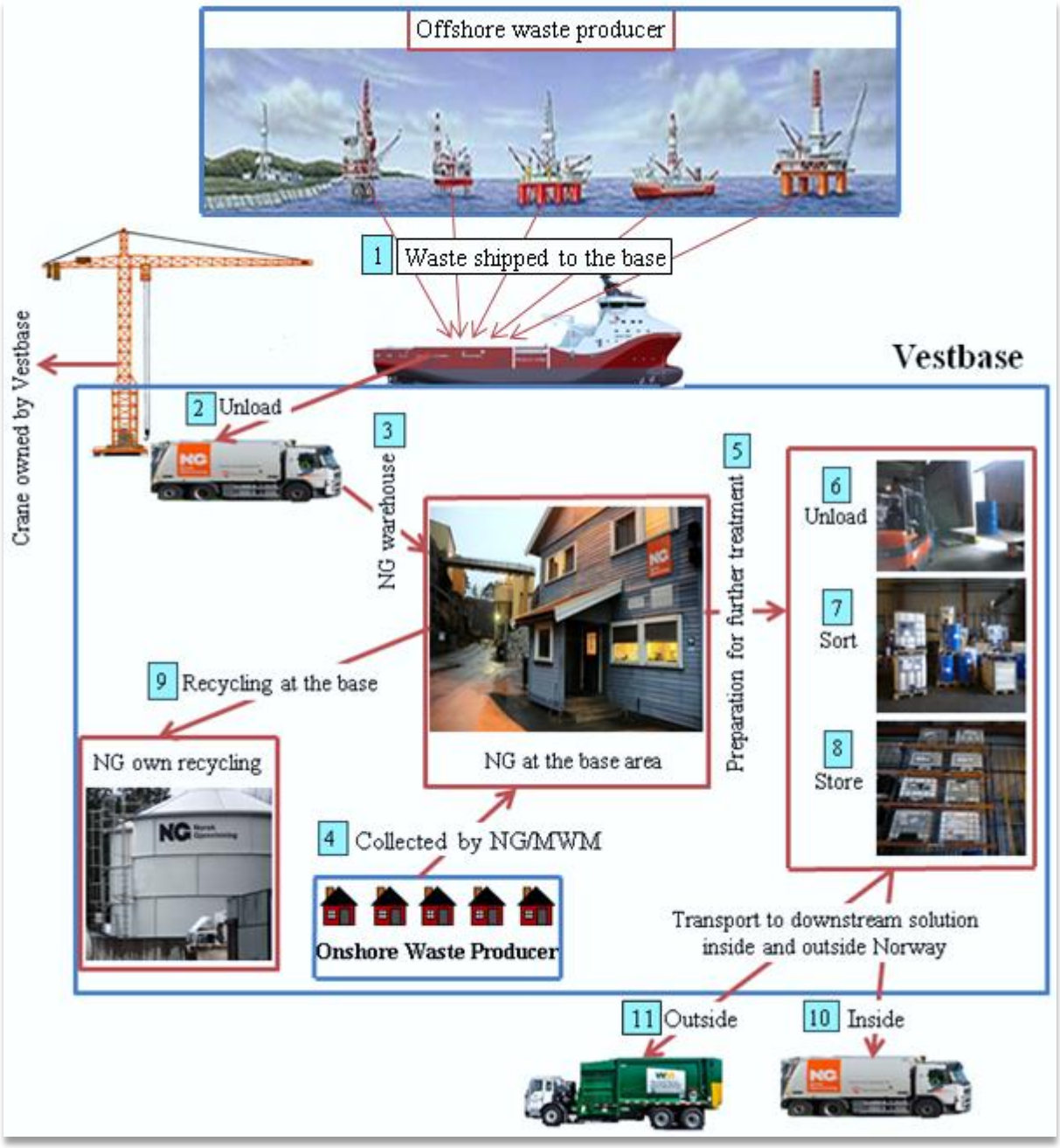


Figure 23: Flow of waste managed by Norsk Gjenvinning at Vestbase.

The figure describes the waste management process at Vestbase into three main stages: unloading, sorting, storing and transporting to downstream parties for further solutions. The following activities are included in the waste management process based on the aforementioned figure.

Ships arrive at the port: The offshore waste producers produce most of the waste handled at Vestbase. These wastes are transported from offshore rigs to the onshore base through

ships. Transporting waste from rigs to the onshore base a waste producer needs to fulfill some requirements. These requirements are namely the type, color and size of containers used to transport waste. It also includes that the container is open or closed while transporting. Table 2 in Appendix B shows details of shipping requirements of wastes.

Crane operation to unload: Mentioned earlier that Vestbase unloading facility is done by its own equipment and personnel. The following factors are considered while unloading the waste containers from supply ships. The crane and forklift is in good working condition and is capable of lifting waste container; taking precaution that the unloading of waste materials are safe and secure. This is important because some of the materials are dangerous in nature and can cause damages to humans and environment, and making sure that the unloading facility has enough space to sort the materials temporarily on the base and load in other vehicles to transport to downstream parties.

Decoration and record checking: Each time waste is sent to the onshore base with detail description in a checklist. This detail description is called the decoration. Decoration includes all necessary information regarding waste, for example, name, address, and contact information of waste producer; billing address; types of waste; number of units; quantity; danger content; special caution if needed; and where to send. Appendix D shows the decoration form of waste transportation.

Initial or temporary sorting on yard: The initial or temporary sorting on yard takes place to keep the waste materials on yard for a short period of time. The temporary sorting is done to cluster the waste materials based on necessity and characteristics. The waste materials for example, heavy metal is sent to the material recovery company. On the other hand, drain water is sent to the recycling plant.

Materials for repairing company: In the initial sorting on yard, not all the materials are sent to the waste company. Some materials are sent to the repairing company for material recovery. These materials can be repaired and used for same rigs or another rig.

Materials for waste handling company: Some materials are sent to the material repairing company, rest of the waste materials are sent to the waste collection company. Sometimes transportation of these waste materials is done by waste collection company and vice

versa. The waste collection company transports waste materials to its own facility. These waste materials are now ready to sort, store and transport to downstream parties.

Furthermore, Vestbase mostly deals with offshore waste. A significant part of offshore waste contains hazardous waste. Sorting, storing and transporting of wastes need to fulfill some strict regulation. These regulations are formed by government concerning social, legal and environmental factors. The following activities include all the sorting and storing procedures based on the abovementioned figure.

Unloading from vehicle: The unloading of waste takes place after the waste collection company transports waste from Vestbase handling facility to its own warehouse. The unloading part is done by firm's own equipment and personnel. High precaution is taken to unload the waste.

Decoration/record checking: Like the waste handling part, sorting and storing needs to check the decoration. This decoration contains necessary information like waste producer, quantity, billing address, etc. (See appendix D).

Placing into designated bag/pot/container: At this stage waste material is placed into designated container. The sorting takes place based on the radio activity or danger content of waste. For example, the packaging of waste needs to consider the following guidelines, indicating which packaging group, is used for a particular waste material. Packaging group indicates the following three categories (See table 7 in Appendix B): Packing Group I – high danger, Packing Group II – medium danger and Packing Group III – low danger.

Labeling or coding: Once the waste material is packaged, it is time to label or code the waste. The coding depends on several factors for example, waste code, color code, ADR class, and UN-no. Table 3 and 4 in Appendix B show the labeling or coding of industrial and metal wastes respectively.

Waste code: It is the characterization of waste for identification and sorting. The code defines that how a particular waste is treated. This code is used in an Enterprise Resource Planning (ERP) system. Table 3 and 4 in Appendix B shows the waste code industrial and metal wastes respectively.

Color code: Designated color of bags/bins/containers is used to keep waste. This code is used to know easily what to do with the waste in a proper way. Table 3 and 4 in Appendix B shows the color code of industrial and metal wastes respectively.

ADR class: It indicates the classification of hazardous materials by ADR based on danger. Table 5 and 6 in Appendix B shows the classification of hazardous wastes based on ADR class.

UN-no.: It is a 4-digit number assigned to different transport categories that measures maximum amount of materials can be carried at one time. Table 5 in Appendix B shows the sorting of hazardous wastes based on UN-no.

Placing in designated area/rack/shelf: Here the waste materials are placed in the designated area inside the warehouse for a short period of time. In the data collection process the warehouse decoration is observed. The waste materials are stored in a way that similar waste materials take place together because of their homogeneity.

Dispatch to downstream parties: The wastes are transported to the downstream parties for further treatment. The downstream parties recover energy, produce heat, and some other value added activities to the waste flow. The details of the value creation of the waste in discussed in the last section of the empirical case description.

4.3.3 RQ3. What characterizes the RL processes of the types of waste managed through Vestbase?

Similar to the previous two sections, this section also discusses the respondents' views regarding the RL impact on WM. Based on the replies; the logistics network is developed and shown in figure 24.

Regarding the association of RL with WM, the respondents were asked several questions. Some of the questions are:

- How do you transport this waste?
- What are the parties involved in the transportation process?

- Could you please describe the network of transportation in the waste logistics process?
- How much is degree of logistics integration in the WM flow?
- How logistics performances influence value creation in the waste flow?
- What are the obstacles do you face in case of waste logistics?
- What is your suggestion to overcome from those problems you mentioned? And so on.

The respondents of Vestbase replied following ways:

- "Transportation is well integrated in the waste management system. Although, we do not transport on our own, however, from our cooperation with the WM companies at the base and other places, it is certain that logistics is one of the important activities in waste transportation".

The responses from the respondents of Shell are as follows:

- "Logistics performance has a great impact on WM performance because it incurs the substantial amount of cost in the whole process of WM".
- "Transportation has substantial impact on value creation from waste because if we can reduce the transportation cost it is good for us".

The respondents of Norsk Gjenvinning (NG) replied in the following ways:

- "Logistics is our main concern because we spend a large portion of money on logistics of the whole waste management system".
- "We have our own transportation facilities. However, sometimes, shipment of waste at a long distance or out of Norway are done by other third party logistics service providers"
- "We think it is a problem to transport waste at a long distance for further treatment because it costs a lot for us".
- "We think transport of a small amount of waste to Denmark is not worthy because sometimes it costs more than what we get from that waste"
- "We think if we have further treatment facility close to the waste production areas then we do not need to transport these wastes at a long distance in Norway or out of the country. Therefore, we can save more money and create more value from it"

The responses from the respondents of Maritime Waste Management (MWM) are as follows:

- “Logistics is the main activities in the waste transportation system”
- “We have some transportation facilities but mainly we have contracts with other logistics service providers”

Therefore, in the previous section (section 4.2.3.1) the whole process of WM at Vestbase is shown in the figure 23. That figure also demonstrated some parts of RL activities at Vestbase’s WM. However, in this section, only the RL integration in WM is shown. This is shown figure 24. This logistics network is developed based on the data collected from all four actors through interviews and field observations.

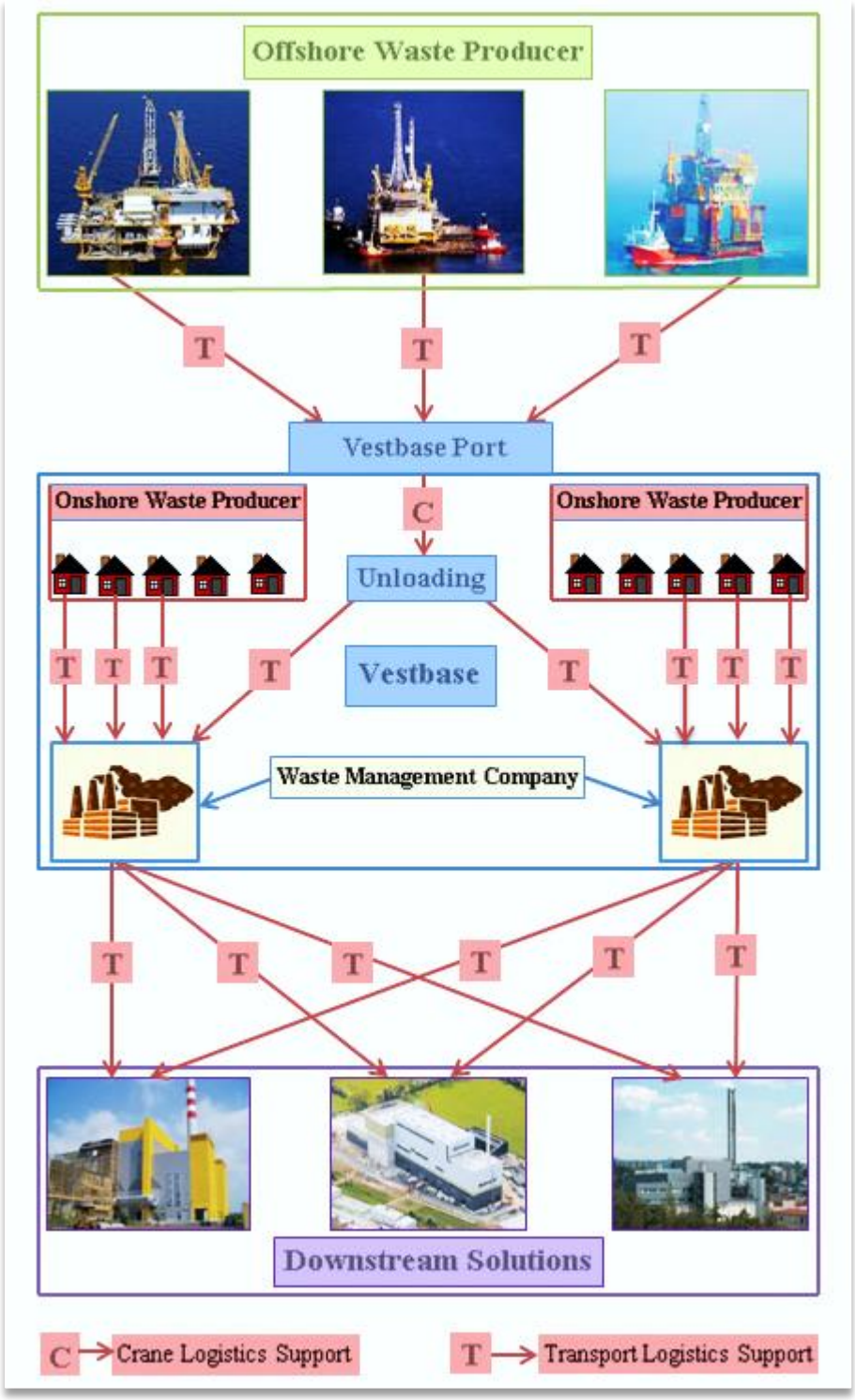


Figure 24: The reverse logistics activities in the waste management process at Vestbase.

This figure explains the logistics network of waste at Vestbase. The flow of waste starts from the waste production at offshore and onshore base. 'T' indicates the transport logistics support and 'C' indicates the crane logistics support. The offshore wastes are

shipped to the port through ships. These wastes are then unloaded through crane facilities provided by Vestbase. There are onshore waste producers as well produce waste at the base. All the wastes are collected by the waste management companies.

Furthermore, these wastes are transported to the downstream parties for further treatment. Some further treatment facilities are inside Norway and some are outside Norway. Therefore, it is clear that logistics is intensely integrated into the waste management process. However, there are problems in the logistics of waste management system. It is found that some of the actors prefer waste treatment facility close to the waste production spot. The detail is discussed in the analysis chapter.

4.3.4 RQ4. How do these wastes, along with RL processes, create value in the WM network?

Like other parts, this part also shows the respondent's views on value creation in WM network. Afterwards, value creation model at Vestbase is shown in the following section in figure 25.

At this stage, the respondents were asked several questions to know the aspects of value from waste management. Some of the questions are:

- What is the value of waste?
- Could you please mention the measurable and non-measurable aspects of value from waste?
- Do you think more value can be recaptured from waste?
- What are the potential ways to recapture values from waste?

The respondents of Vestbase replied following ways:

- "Some clever guys already started the waste business, it has a lot of money and it is value. Though, there is strict regulation, but it has a lot of financial impact".
- "We make money out of waste handling and oil companies get environmental good will".

- "All the parties in total waste management flow have some contribution, so everybody take part in the value creation process and everybody get something in return".
- "Some of the return parts from the oil rigs are reused after repairing".

The responses from the respondents of Shell are as follows:

- "The final consumer like you and me has barely involvement with the waste management process. However, we take care about the environment and it is one of the important value creation aspects to us. It helps to keep the company reputation up and create good will to the final consumer".
- "In terms of monetary value we do not earn much, the waste handling and processing company make money from waste. They recycle and incinerate the waste to produce new product or energy".
- "We do not landfill anything, except the mud, which has no use to us".
- "To recapture more value from waste we need more cost efficient and environment friend technology. The initiative has to come from the waste management company".
- "We all work together as a network, we are dependent on each other and I think everybody get some return".

The respondents of Norsk Gjenvinning (NG) replied in the following ways:

- "We earn money from waste handling and processing"
- "Keeping the environment safe and clean is value to us"
- "Waste management create employment"
- "Some wastes are recycled and used as raw materials to produce new products"
- "I would say energy recovery is very important value creation from waste"
- "More value can be created if we can reduce the transportation cost. It can be done by not sending the waste far away or out of Norway".

The responses from the respondents of Maritime Waste Management (MWM) are as follows:

- "We earn money from waste management. We sell our service to oil companies and companies at the base".
- "It has positive environmental impact"
- "Overall I would say waste is something valuable"

- “To recapture more value technology should be more advanced for cost effectiveness and cleaner process”.

Furthermore, at the end the respondents were asked the main building block question of the study, i.e., ‘what do you think now, does waste really mean waste?’ Indeed, all the respondents acknowledged that waste is something valuable. Some of the replies are:

The respondents of Vestbase replied following ways:

- “Waste is absolutely not waste”.
- “It is something valuable”.
- “Ordinary people do not understand the value of it”.
- “Many people are making substantial money out of it”.

The responses from the respondents of Shell are as follows:

- “Definitely it is something valuable”.
- “No question waste has value”.
- “We consider waste as value”.

The respondents of Norsk Gjenvinning (NG) replied in the following ways:

- “It has some value, already I have mentioned”.

The responses from the respondents of Maritime Waste Management (MWM) are as follows:

- “We do not consider waste as only garbage; we know many people are doing business with the waste, so for sure it has some value”.

Therefore, based on the replies recorded from the interview, along with other information provided by the actors, the following value creation model is developed.

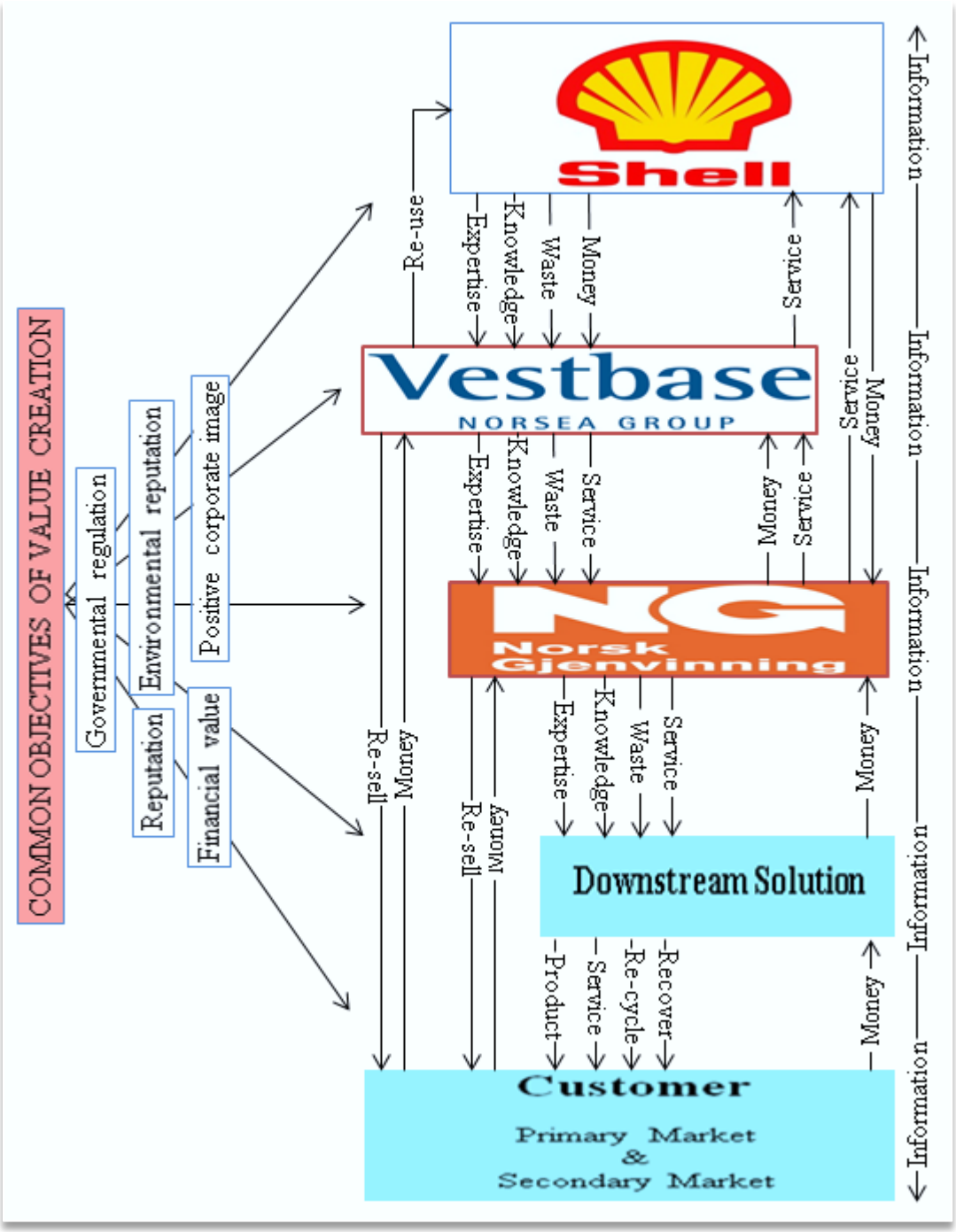


Figure 25: Value creation from waste in the waste management network at Vestbase.

This figure describes the value creation process from waste management. The onshore and offshore waste producers buy services from Vestbase to use the port and technical facilities. In return, Vestbase gets money from the waste producers.

Furthermore, NG further handles these wastes and creates value from it. To handle and process these wastes NG gets money from the onshore and offshore waste producers. NG

then sells these wastes to further downstream parties and receives payment out of this transaction. Therefore, along with the financial value, by processing these wastes NG gets environmental reputation. Consequently, it helps to build positive company image.

In addition, the downstream parties are the ultimate value creator from this waste. They use some of the materials as raw materials for further production process for example; the mercury and other parts of batteries are used for further production. Moreover, they refine oil from the waste oil, burn wastes to produce energy. In addition, they produce sand and gravel from the bulk drain wastes. These, oil, sand, gravel and energy are sold to final consumers.

However, the waste producers do not get any direct financial benefit from this waste management. It is the governmental regulation to proper use and management of waste. Therefore, in spite of not getting any direct financial benefit, waste producers generate environmental reputation. Consequently, it helps to build strong corporate image. The positive corporate image creates customer loyalty and thus generates higher sales for Shell. Moreover, the waste producer, especially Shell, shares their technical knowledge and expertise with the waste management companies when needed.

4.4 Summary

Therefore, all the parties in the waste management process contribute in the value network, when they become the owner of the waste. From the contribution in the value network, each party receives something valuable in return, for example, financial and non-financial benefits. Furthermore, all the actors acknowledged that waste is not simply garbage, it is something valuable. However, there are obstacles in the waste management process to create higher value. The main obstacle is the logistics costs.

In addition, there are other recommendations from the actors are noted, for example, newer and more advance technology can help to create more value from waste. Furthermore, there were suggestions from actors to build treatment facility close to the waste production area. However, the actors as well considered that it is a costly matter to set up treatment facility close to the waste production area. Therefore, new solution and potential strategy is essential to solve this problem.

5.0 Chapter Five: Empirical Analysis and Discussion

5.1 Introduction

The purpose of this study is to understand how value emerges from waste and find areas of improvement where there is potential to increase value creation along with the reverse logistics process. Moreover, section 2.5.4 formerly mentioned that previous studies barely specified and discussed the role of the owner in the waste flow. Furthermore, empirical findings reveal that, in the waste supply chain, from waste producer to the waste collector and transporter, the movement of waste (raw materials) and money flow in the same direction. However, in the traditional buying and selling process of goods or services, the goods and money flow in the opposite direction. Conventionally, money is paid to achieve the goods or services. Nevertheless, in waste flow money is paid not to acquire the goods, rather to clean up or further processing the wastes. This conflicting trend between traditional supply chain and waste flow is not discussed in any previous literature so far reviewed for this study. Therefore, an innovative contribution of the study is, clearly define and describe the relationships of the parties in the waste flow.

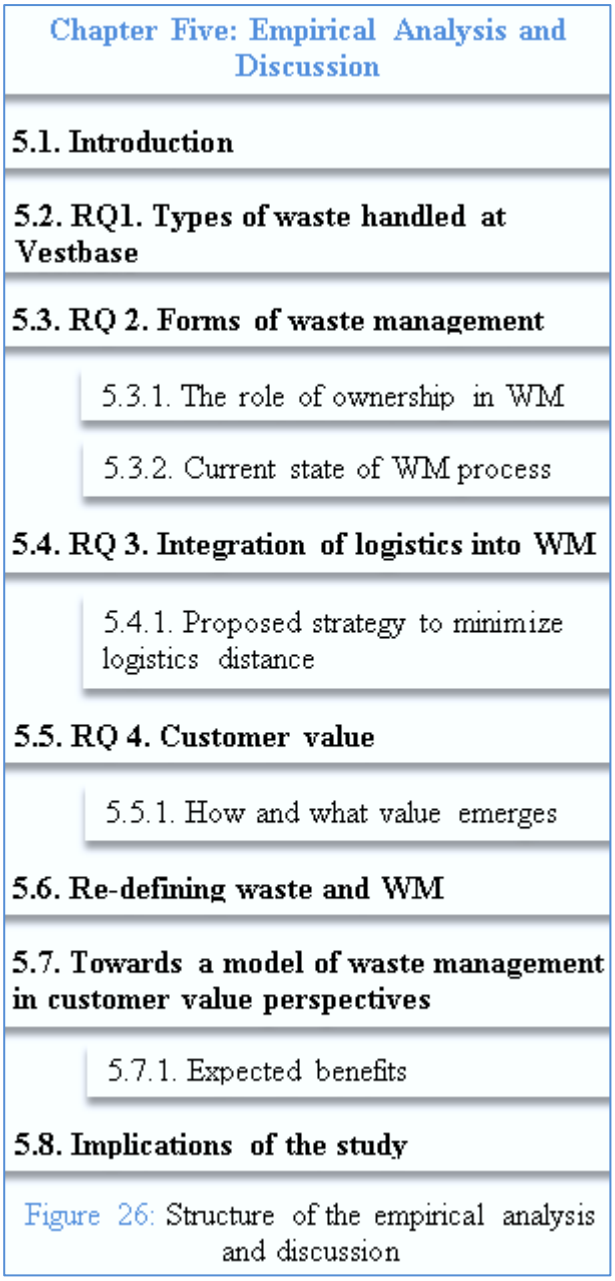


Figure 26: Structure of the empirical analysis and discussion

In addition, new definitions of waste and waste management are provided in the discussion section. Moreover, after analyzing all the challenges and barriers a proposed value creation

model is developed. The model shows how higher value can be created from waste management. The model is developed based on the empirical findings and backed by literature reviews.

5.2 RQ1. Types of waste handled at Vestbase

The first research question is purely technical and it seeks to evoke and help classify different types of waste. This was the foundation for further research and analysis. Thus, the first research question is for the basic understanding of waste.

The empirical data indicates that types of waste at Vestbase are divided into industrial, bulk, metal, and hazardous wastes. Each fraction of waste is further divided into several sub-fractions. The details description of each fraction is given in the data description chapter. However, the short lists of all the fractions of wastes are mentioned below.

Industrial wastes are divided into wet organic waste, combustible or food contaminated waste, paper, cardboard (brown paper), soft plastic, hard plastic, wood, glass, EE-waste, medical waste, general waste, homogeneous general waste and mixed (non-conformance).

Similarly, bulk waste includes drain water, which is polluted water, generated from oil platform. Besides, metal waste is divided into metal, wire, empty barrels, miscellaneous noble materials and cable waste.

Moreover, hazardous waste is divided into batteries, sandblast waste, fluorescent waste, paint, oil contaminated material, spray cans/aerosols, drilling waste, chemical mixture without halogen, chemical mixture with halogen, chemical mixture without heavy metal, chemical (pure product) without halogen; and heavy metal, chemical (pure product) with halogen and chemical (pure product) with heavy metal.

De Brito and Dekker (2003) argued that waste management is the collection and processing of waste that has no longer any reuse potential. The author emphasizes only collection and processing of waste. In addition, this definition also indicates that wastes are something which has no re-use potentials. However, the empirical data shows that waste management is not only the collection and processing of waste materials, but also value creation from waste. One of the respondents agreed that:

"We do not want to dispose anything until we ensure the proper utilization of wastes. We want to re-use, recycle, and recover energy from waste. Therefore, it has value"

The empirical data shows that all abovementioned wastes are considered as the raw materials for further production process. Respondents agreed that the first priority of any waste is recapturing value. By value recapturing the responded basically meant proper utilization of waste, which can add "something" to the holder of waste. The word "something" indicates value, which are monetary value and non-monetary value. Therefore, it can be argued that value exists into an object in its whole lifespan until it is disposed and goes back to its origin (the earth). The details of monetary and non-monetary value are described in the customer value section.

Therefore, significant questions can be raised that, if these wastes materials contain value, why are they called waste? Similarly, at what stage or condition an object is considered as waste? There is no clear indication or decision strategy that when and which point an object can be considered as waste. McHale (2000) raised that which physical parts and products can be lawfully regarded as waste? The empirical study suggests that the answer of these questions depend on the willingness of the owner or holder, whether or not the owner wants to further process the waste.

If the holder wants to use the waste materials for any further process then it is not considered as waste. However, if the holder does not want to use the waste material any more then it is considered as waste and it fulfills the definition of De Brito and Dekker (2003). However, from the empirical investigation it is clear that all the parties create value from waste management because they use the waste for several purposes and it creates value as a flow of waste materials. Therefore, an object is considered waste only when the flow of value creation of the further processing of that object is stopped by the owner.

However, the empirical data suggests that the final owner considers the object as waste. Who will be the final owner depends on the nature and type of waste. Some waste for example, oil contaminated mud is directly disposed by the first owner after refining it,

because the owner does not find any potential in the waste to create value. Some other wastes, for example, MSW are considered as wastes after recovering energy. Hence, the term waste is subjective and it depends on time and its transformation process to consider an object as waste.

Therefore, based on the abovementioned understanding of waste, the succeeding sections of this chapter focuses on answering the three remaining research questions. These research questions are answered based on the theoretical understandings developed in the literature reviews along with the empirical findings. Consequently, new definitions of waste, WM, relationship with reverse logistics and value maximization model in WM are developed.

5.3 RQ2. Forms of waste management

The study reveals that the purpose and role of waste management is turning waste into valuable objects to recapture value. The makeover from waste to valuable object helps to create value in every stage of its transformation process. However, this transformation process poses different challenges in every stage of its movement. In the case of petroleum, MSW and industrial waste, the waste is a by-product of some economic activity. However, in case of non-petroleum waste, and WEEE, the issue is about an object that has previously served its purpose and has been disposed by its owner when turned into waste.

5.3.1 The role of ownership in waste management

Pongrácz & Pohjola (1998) define ownership as the right and responsibility to act upon an object that is in the custody of the owner. Therefore, the role of owner in waste management is significantly important because the owner decides whether or not the waste will be further processed. The decision of further processing depends on whether or not the waste (raw materials for final products) is able to recapture greater value than the processing cost. If the waste cannot provide higher value than the processing cost, it is disposed.

Pongcraz (2002) argues that the owner assesses the performance of the object or material and it is also possible that the owner can re-assign a new purpose for the same object.

Similarly, the concept of ownership in WM is clear and obvious is EC waste directives. European Council (1997) states that, the waste producer, importer, distributor and consumer should bear the specific share of responsibility to prevent, recover and disposal. Therefore, the owner's active participation is important in proper WM process and reclaims value from it.

Similarly, the empirical data evidence that in each stage of waste management process, starting from waste production to final consumer, the owners have some specific responsibilities. The owners take part in the waste management process and create value in each stage of transformation.

Moreover, the empirical data suggests that the waste producer (Shell) is the initial owner of waste. Shell buys services offered by NG to collect and transport the waste for further processing. In this initial stage, Shell (waste producer) has the role to set the strategy and pay to NG for efficient value recovery. However, the role of the first owner as a waste producer is not finished through only paying for services to WM company for collecting and transporting the waste. The waste producer provides instruction and inspection services until the end customer get the final product created from waste or safe disposal by the waste processor (owner 3, shown in figure 2). One typical response from the waste producer (Shell):

> *"We have contracts with companies, for example, NG, to further treatment or processing of waste. There are challenges to audit, inspect, and influence all the waste contractors to safe and environmental friendly treatment of waste".*

Furthermore, in the role of ownership, NG is the second owner of waste. The role of NG is to collect all sorts of wastes from different waste producers and gather them in the warehouse until there is enough volume to transport to further downstream solution. After having enough volume NG transports these wastes to the waste processors for value recovery. However, few WM companies have some own treatment facilities to treat the waste. WM companies sell these wastes to the downstream solutions where these waste turns into useable products and finally disposed of. One notable reply from NG is:

"We do not treat all the waste at the base on our own; at the base we only have recycling plant where we recycle drain water. We have downstream parties in the waste management network, who recover energy and after that landfill some of the wastes".

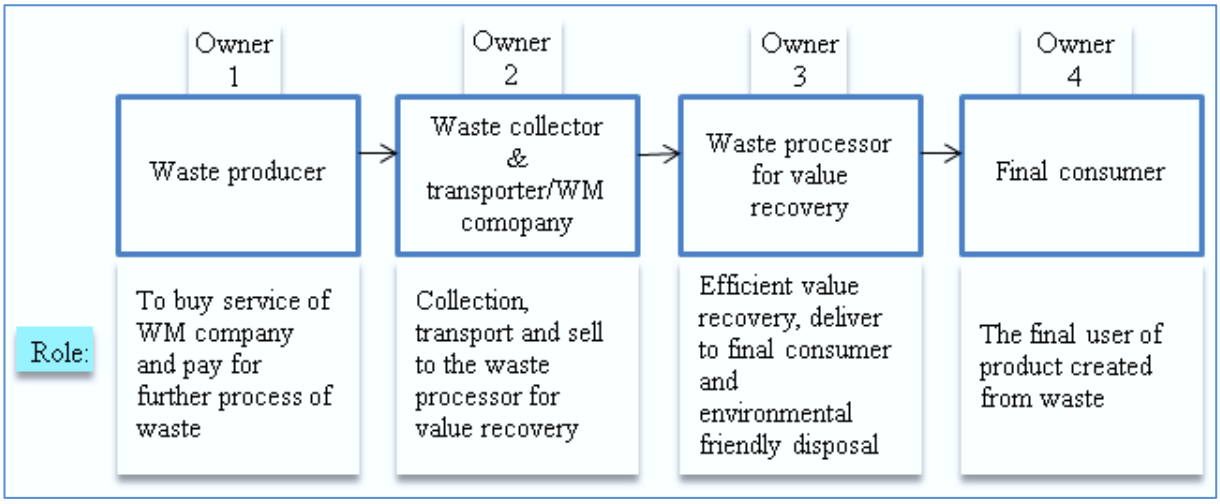


Figure 27: Role of ownership in waste management process.

Moreover, the waste processors are the third owner of waste after they buy the wastes from the WM company. In this facility, some of the wastes are reused and recycled. The recycling of waste helps to create final useable products for example, artificial grass for the soccer ground from car tires, useable oil from oil waste and MSW, sand and gravel from sandblast waste and energy recovery from MSW etc. This owner is also responsible for safe disposal.

In addition, Oksanen (1998) discusses that waste management is not only the responsibility of the owner, but also an ethical consideration. The author emphasizes that what one is allowed to do with one's property is an ethical issue. Therefore, owner's ethical intention in waste management can ensure an efficient waste management system for value creation. Similarly, the primary data of this study backs this argument. The respondents agreed that besides governmental regulation, it is an ethical concern to treat any waste based on its prescribed method.

At the end, customers are the final owner of products or services created from wastes. The final customer can be a company or individual customer. Whether the final customer is a

company or individual has the similar role to ensure the efficient use of the products or services. According to the ownership theory, the efficient and environmental use of products by the owner (final customer) can help to minimize waste generation, which is the highest priority in EC (1997) waste hierarchy.

Therefore, it can be argued that the role of owner according to the waste management theory developed by EC (1997) is followed and implemented thoroughly by the focal firms. Similarly, the role of ownership concept in waste management discussed by Pongcraz (2002) is followed all over the abovementioned waste management process. However, the role of owner to ensure an efficient and effective waste management process depends on availability of advance technology, flexible governmental regulation and cost-efficient logistical support. These barriers are found in the empirical investigation. The details of how to overcome these barriers are discussed in the fourth research question.

5.3.2 Current state of waste management process

According to the EC theory of waste management (2008), the treatment process is divided into four stages: re-used, recycle, recover and disposal. Similarly, the empirical analysis shows that the waste is managed through the similar four steps process. However, the management of waste varies based on the types and characteristics of waste that how many stages to go through to recapture value. This study considers petroleum and industrial waste, which has the following value recovery structure:

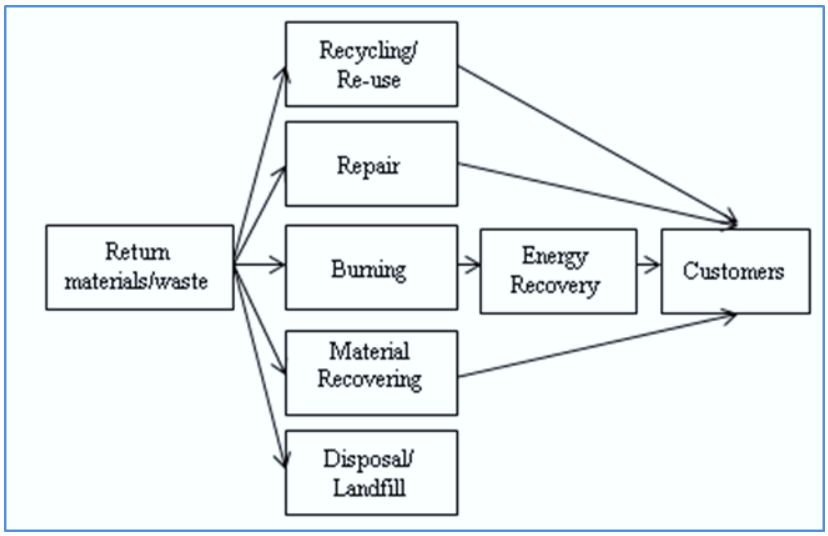


Figure 28: Current waste management in networks at Vestbase in different stages.

The current state of the WM process shows that wastes are collected from the waste producers by the WM company and vice versa. These wastes are temporarily stored in the yard of WM company for further transportation to another processor in the waste supply. The processing solution can be inside or outside Norway depending on the characteristics and toxicity of the waste, which is shown in the figure 28.

Moreover, empirical data shows that waste management company does not process any waste in its own plant except contaminated water. These wastes are sent to the downstream parties for further treatment to recycle and recover energy. The downstream solution provider recycles and recovers energy which is sold to the final consumers.

Furthermore, the primary data reveals that there are challenges and barriers in the current state of waste management. These challenges and barriers are deterring the value creation from waste management. The challenges and barriers are mentioned and discussed in section 5.7. To cope with these challenges and removing the barriers a proposed value creation model is developed in the same section. The model is developed by the evidence of empirical answers and assisted by the literature theories.

5.4 RQ3. Integration of logistics into waste management

Rogers and Tibben-Lembke, (1999), define RL as, "the process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin, for the purpose of recapturing value or proper disposal" (p. 2). Therefore, it can be argued that one of the main attributes of this definition is efficient logistical support.

Similarly, the empirical data shows that integration and involvement of logistics has significant effect on the performance of the waste management process. One of the respondents unambiguously supports the idea. According to the respondent of NG:

> *"Logistics performance has a great impact on the success and profitability of WM because it incurs the substantial amount of cost in the whole process of WM"*

Therefore, it can be argued that logistics is well integrated into the WM process. The empirical data description (figure 18) describes the current state of the logistics integration into the WM process. The condense figure of the integration of logistics into WM is shown below:

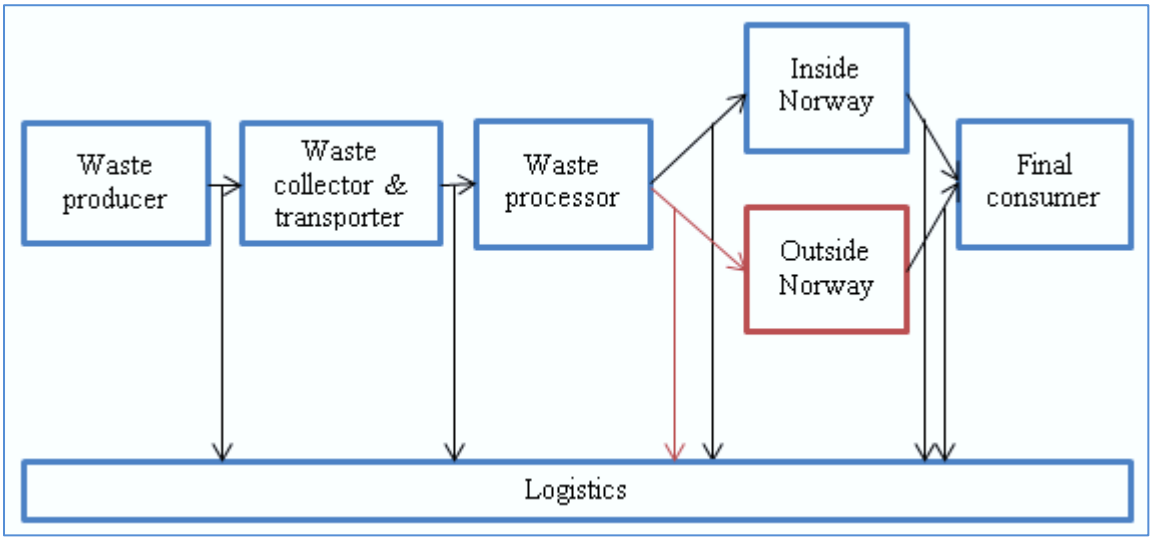


Figure 29: Logistics integration in waste management in networks at Vestbase.

This figure shows the logistics involvement in waste management process. The empirical data shows that waste treatment to re-capture value happens inside and outside Norway. Due to the governmental regulation some wastes, for example, high toxic hazardous waste, are sent out of Norway for further treatment. In addition to this, this logistical cost is one of the top cost factors which affect the profitability of the waste management. Similarly, empirical data suggests that increase in logistical costs is the cause of rare value creation. Respondents of NG were asked regarding transport of waste out of Norway. Two respondents replied:

> *"Transportation has substantial impact on value creation from waste because if we can reduce the transportation cost it is good for us. We think transport of a small amount of waste to Denmark is not worthy because sometimes it costs more than what we get back from that waste"*

Similarly, not only outside but also long distance transportation of waste inside Norway, causes higher cost and lower profitability from waste management. One vital reply from one of the respondents of NG:

"We think it is a problem to transport waste at a long distance for further treatment because it costs a lot for us"

Therefore, both theoretical and empirical findings show long distance transportation, whether inside or outside Norway, is one of the main barriers to recapture maximum value from waste. Some of the respondents from WM company suggested that setting up waste processing facilities, on their own or in a shorter distance, can help to maximize value. Consequently, it is essential to develop a new waste management structure in respect with logistics involvement.

5.4.1 Proposed strategy to reduce logistics costs

The interview indicates that logistic cost is the most significant fraction of cost in waste management process. The respondents agreed that considering the current waste management strategy, one of the main goals to create value from waste can be to reduce the logistical cost. The suggestion to reduce logistical cost came from the respondents as evident in the following statement:

"We think if we have further treatment facility close to the waste production areas then we do not need to transport these wastes at a long distance in Norway or out of the country. Therefore, we can save more money and create more value from it".

Therefore, the proposed waste management strategy suggests that the logistical /transformation cost should be reduced to create value from waste. It can ensure more monetary return from waste management. However, it is necessary to triangulate the empirical data with the reverse logistics theories mentioned in the literature reviews (Yin, 2009). Thus, it can increase the validity and acceptability of the proposed model.

The independent RL process model developed by Blumberg (2005), shown in figure 4, discusses the reverse process of waste materials. According to this model, the reverse process starts with collection of trash and junk materials and ends up with selling or disposing of wastes. This model does not clarify all necessary four steps of waste

management developed by EC (2008), where reuse, recycle, recover and finally disposal is the main objectives of waste management.

Thus, it can be argued that this model completely ignores the necessary steps of waste management proposed by EC (2008). Moreover, this model is not consistent with the empirical findings of this paper, where it is found that long distance logistics is the main barrier to capture maximum value.

Similarly, the recovery process model presented by Cherrett et al., (2010), shown in figure 5, explains the recovery process incorporated in the supply chain. This model explains the logistics involvement in the recovery process which is significantly long and creates the same problem, which is raised in the empirical findings.

Hence, any of these models cannot solve the current raised problem of waste management related to logistics. Consequently, it leads to the necessity of creation of the proposed new waste management model related to logistics.

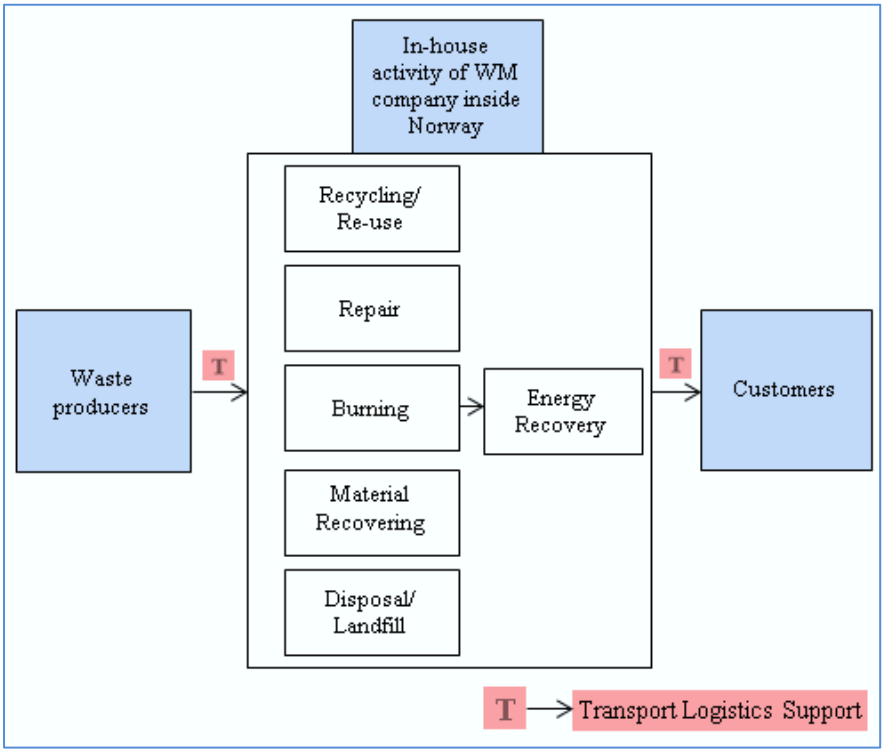


Figure 30: Proposed model of waste management to reduce logistical cost based on the empirical data.

This figure enlightens the proposed model of waste management where the logistical distance is reduced significantly. As mentioned earlier that empirical findings suggest that the in-house waste processing activity of WM company can eliminate further transportation to downstream solution. Moreover, the in-house waste processing activity is proposed inside Norway. The waste processing outside Norway is absolutely eliminated from this strategy.

Based on this strategy the waste transportation happens in three stages. It starts from waste producers to customers and between these two there is an in-house process activity performed by WM company. This strategy shows that the waste producers should pay for transportation of waste to the WM company. The WM company should have its own, or from third party, machinery and equipment to repair, recycle, recovery and disposal of waste. Finally, the WM company can be directed to the final customers.

However, the empirical data shows that it is an expensive matter to set up all waste treatment facilities by WM company. It requires expensive vast amount of land, machineries, equipment, and other necessary facilities to set up in an urban area. Therefore, the probable solution can be to set up WM facilities in a convenient location which is neither located in a far long distance nor outside Norway.

Similarly, this idea of setting up waste processing facilities by WM companies in a convenient location is fully supported by the empirical findings.

5.5 RQ4. Customer value

Christopher (2011) defines customer value is the difference between the perceived benefits from a products or services from a purchase and the total cost of the customer and success or failure of any business. In the existing waste management process the relationships among the parties in the supply chain is not clear. Therefore, it is necessary to clearly define and describe who the customer in the waste supply chain is.

In waste supply chain the waste producer produces the wastes and at the same time the waste producer is the customer that buys services offered by WM company. In the traditional supply chain, the flow of money and the goods go at the opposite direction. However, remarkably, in the waste supply chain the flow of money and waste (raw

materials for further products) go at the similar direction. This trend is not discussed in any of the existing literatures so far reviewed for this study. The comparison is shown as::

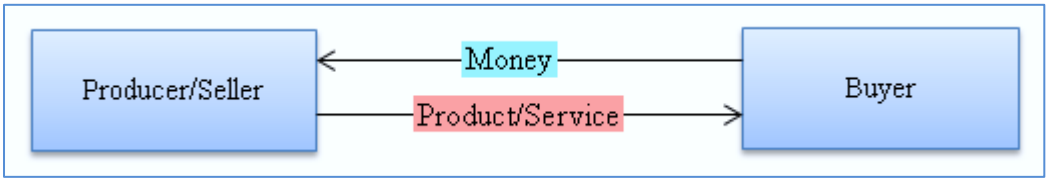


Figure 31: Traditional relationship between buyer and seller in the supply chain (concept adopted from Christopher, 2011).

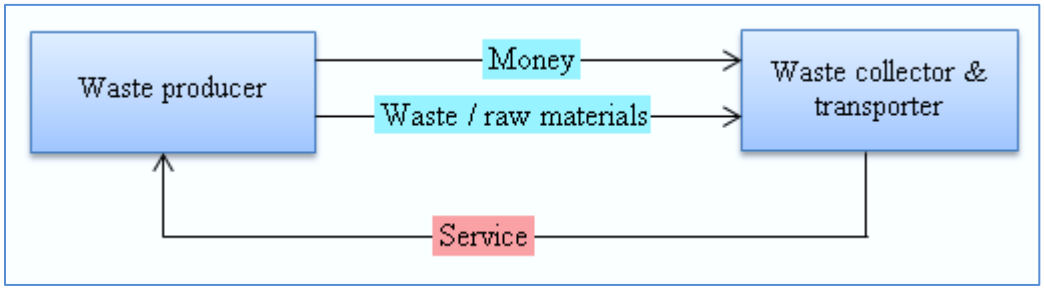


Figure 32: Relationship between waste producer (buyer) and waste collector & transporter (seller).

These figures, 31 and 32, demonstrate the differences between the traditional buying and selling and relationship of parties in waste supply chain. In the traditional supply chain, customer receives the product in return of financial means. However, in the waste supply chain the customer (waste producer) does not receive the product rather it pays for getting rid of the waste (raw materials for further product). Nonetheless, the waste producer (customer) receives services from the waste collection and transportation company. This services help to build positive corporate image for the waste producer.

However, the waste producer is not the only customer in the waste supply chain. There are secondary customer and final consumer too. The waste producer is the primary customer. The waste treatment company is the customer of WM company, which is engaged in further treatment and value creation. Therefore, the waste treatment company is the second customer. Finally, there are final consumers who get the products created from waste. The relationships are shown in the following figure:

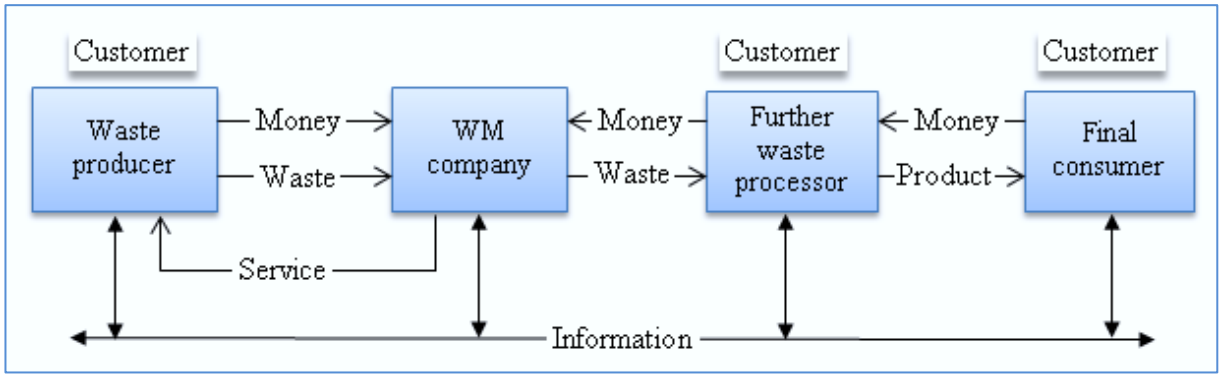


Figure 33: Relationship among the parties in the supply chain process of waste.

The figure shows the relationship among parties in the supply chain process of waste. The waste producer is the customer that buys services from WM company to ensure further process of waste. In return of the service, waste producer pays WM company along with the waste, which is considered as the raw materials for further production. The waste processor is the customer who buys wastes from the WM company. In return, it pays to the WM company. The final customer buys the product produced from waste, from the waste processor, and in return they pay to the waste processor.

Similarly, the empirical evidence shows that in the waste supply chain, WM company earns money from both waste producers and waste processors. However, all the actors in the abovementioned waste supply chain get something in return. The return is called the value for the actors. Moreover, value is created not only for actors in the supply chain but also for others who are not the actors in the supply chain. The detail is in the next section.

5.5.1 How and what value emerges

The study reveals that value emerges for not only all the parties in the waste supply chain, but also non-actors outside the waste supply chain. The value emerges as financial and non-financial values. The financial value can be measured by monetary units. However, the detected non-measurable values are environmental value, process improvement, goodwill/reputation, knowledge sharing, and relationship building etc.

As anticipated, most of the participants identified value creation through monetary, environmental and social responsibility related values. Rutner and Langley (2000) describe value in terms of monetary and non-monetary standpoints. They further define the monetary value as measurable and non-monetary values are worth, usefulness, quality,

desirability and importance. Moreover, Rockwell Automation (2008) defines total value is the combination of monetary value (ROI), utility and importance. Similarly, in waste management it has been observed that these values are created by the focal firms which are considered as organizational values. In addition, environmental value is created for both organizational and final customer, such as, the respondent of Shell says:

> *"The final consumer like you and me has barely involvement with the waste management process. However, we take care about the environment and it is one of the important value creation aspects to us. It helps to keep the company reputation up and create good will to the final consumer"*

Furthermore, the value perceptions are different to the actors in the waste supply chain. The study exposes that value for the waste producer is to fulfill the governmental regulation, keeping company out of any environmental scandal and building positive goodwill and reputation to achieve long term goal. The waste producer does not gain any direct financial value from waste management. However, the earned goodwill and positive company reputation help to boost up sales, which is indirect financial value gained from waste management.

In contrast, waste management company and the downstream waste processor consider value as monetary value. As mentioned earlier, waste management company get paid from waste producer to clean up the waste. In addition, waste management company sells these wastes to the downstream solution and gat paid once again. However, this financial value is dependent on the logistical cost and implementation because waste management company spends the maximum on logistical cost. Munsami (2011) discusses that logistical cost has a strong influence on ROA. The lower the logistical cost the higher the ROA. Similarly, waste management comopany always tries to minimize the logistical cost, which is evident in the following statement:

> *"Logistics is our main concern because we spend a large portion of money on logistics of the whole waste management system"*

Moreover, the downstream waste processor considers value as monetary value. Firm in the downstream solution recycles the waste raw materials and produces new products. Besides

recycling, it recovers energy from different types of wastes. The energy is in different forms for example, steam, electricity, bio-gas, bio-diesel, non-refined oil, bio-ethanol, compost etc. The waste processing company then sells the products to final customer by means of monetary value.

In addition to this, there are non-monetary values are created by the parties in the waste supply chain. Like traditional supply chain, parties in the waste supply chain shares information, knowledge, technology, expertise etc. These sharing create cumulative value in waste management network to ease operation in the waste supply chain. The values of waste through waste management, monetary and non-monetary, are shown in the following figure:

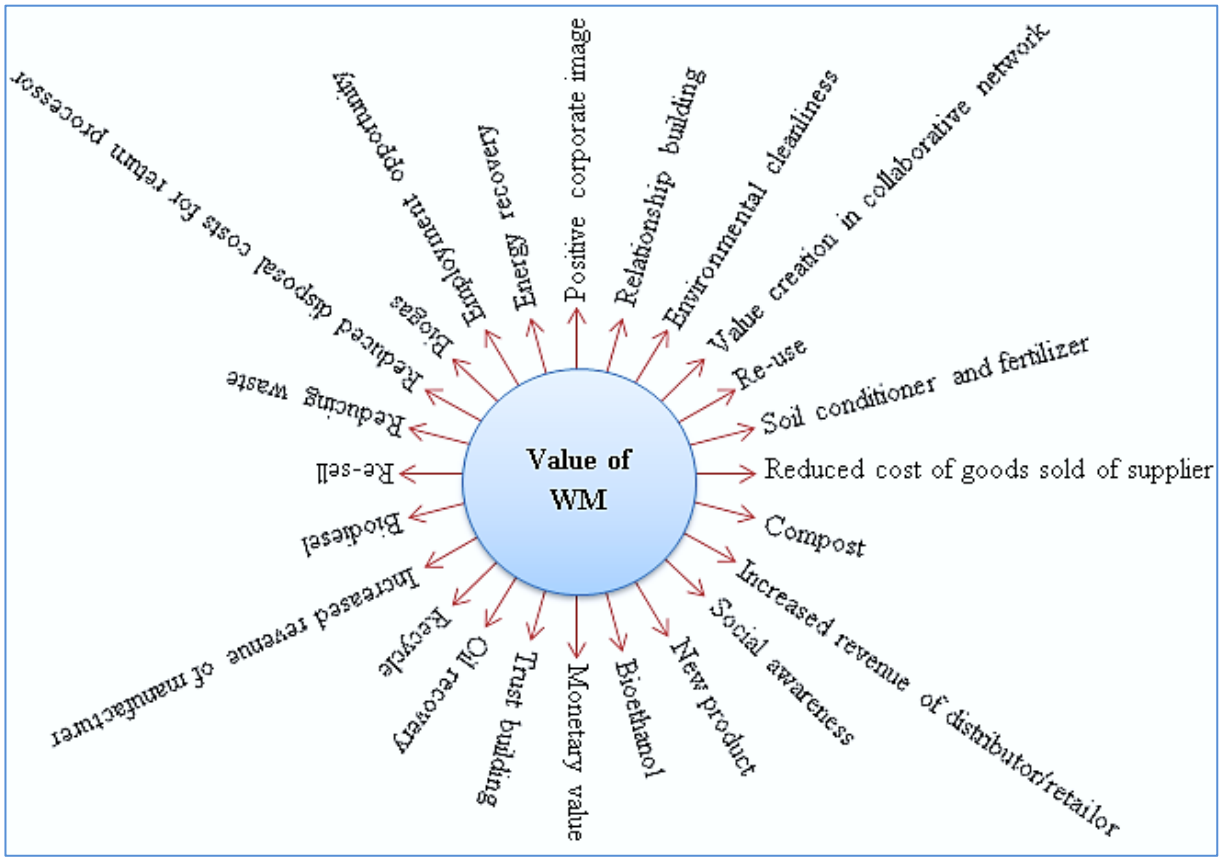


Figure 34: Value creation from waste management process.

5.6 Re-defining waste and waste management

The main concern of this paper is to explore 'does waste really mean waste?' Most of the authors defined waste based on its purpose or function. However, others defined it based on its performance. There is no clear and unique definition that can undoubtedly define

what waste is. Gourlay (1992) raised a question that, "what, then, is waste? Therefore, this study tries to seek answer of the question, what is waste?

Moreover, Ellwood and Patashik (1993) lightheartedly declared that waste, like beauty, is in the eye of the beholder. This definition can only describe the value of waste in owner's point of view. However, this definition does not serve the deeper meaning of waste in business context, which can advocate waste as a valuable object. Therefore, it is obviously necessary to re-define waste and waste management based on the empirical findings of this study.

The respondents were asked one building block question of this study, does waste really mean waste? The empirical findings show that all of the respondents unambiguously considered wastes are absolutely not waste and they are something valuable. Similarly, Pongcraz (2002) argued that an object turns into waste when it has fulfilled its original purpose, not used anymore and its owner failed to re-use because its performance is inadequate. Therefore, based on both empirical and theoretical understandings, waste can be re-defined as:

> *"Waste is a human concept where its value is ignored by its owner, depending on either it cannot performs with respect to its original purpose, or the owner decides not to use it anymore"*

Similarly, in case of waste management the concept of recapturing maximum value from waste is narrowly defined in most of the waste management definitions. The famous and universally accepted waste management definition is provided by the European Council (1991). The Council Directive 91/156/EEC of the European Council (1991) defines, "Waste management shall mean collection, transport, recovery and disposal of waste, including the supervision of such operations and after-care of disposal sites" (p. 33).

This definition of waste management is more concerned about the existing amount of waste. Moreover, it also emphasizes how to minimize the potential impact of waste on human and environment. However, this definition does not cover two important aspects of waste management which are exposed from the empirical investigation.

The first empirical aspect of waste management is to minimize the production of waste materials. The second important empirical aspect of waste management is to recapture maximum value from the existing waste. The respondents emphasized these two aspects as:

> *"It is our first priority to reduce the production of waste as less as possible and secondly, to recapture as maximum value as possible out of whatever waste is produced"*

Therefore, based on both the theoretical and empirical findings, waste management can be re-defined as:

> *"Waste management is the reduction of production of waste materials to protect human health and environment; and efficient collection, transportation, recovery and disposal for the purpose of re-capturing value of materials originally defined as waste"*

5.7 Towards a model of waste management in customer value perspectives

The empirical data indicates that value is created from waste in each stage of its transformation process. The aspect of value is described in the preceding section. Therefore, it can be an important question, why another value creation model is necessary? The answer of this question is clearly evident in the empirical data. By the proposed model the author basically meant higher value creation than present condition.

Broadly, respondents agreed that value is created from waste. However, there are some challenges and barriers are faced by the parties in the waste management process. The parties in the waste supply chain as well as the author believe that overcoming from these challenges and barriers can create higher value than the present condition.

The value creation network in waste management process consists of several actors in a supply chain. Therefore, it can be argued that value creation in waste management process is a supply chain management process of waste flow. Bititci et al., (2004) describe that

supply chain is about collaborative planning, fulfillment and replenishment. However, Bititci et al., (2004) developed a value proposition (VP) model in the supply chains which explains the value propositions that arise from the collaborations of the parties in the supply chain.

Moreover, this collaboration works when the companies in the supply chain contribute to their individual value proposition and then bring into line to the next member of the supply chain. Similarly, in empirical perspectives the value creation network of waste flow comprises of some contributors in a supply chain. This supply chain includes waste producers, direct waste handler, indirect or third party logistics service providers, downstream processor of waste, and finally it ends up with end customer.

In addition, each actor in the waste supply chain contributes to their individual value proposition and then brings it to the line to the next actor in the supply chain. However, the study reveals that there are some influencing factors that hinder the value creation process from waste management. Moreover, there are barriers in waste management to higher value creation from waste. The proposed value creation model in waste management process can be shown as:

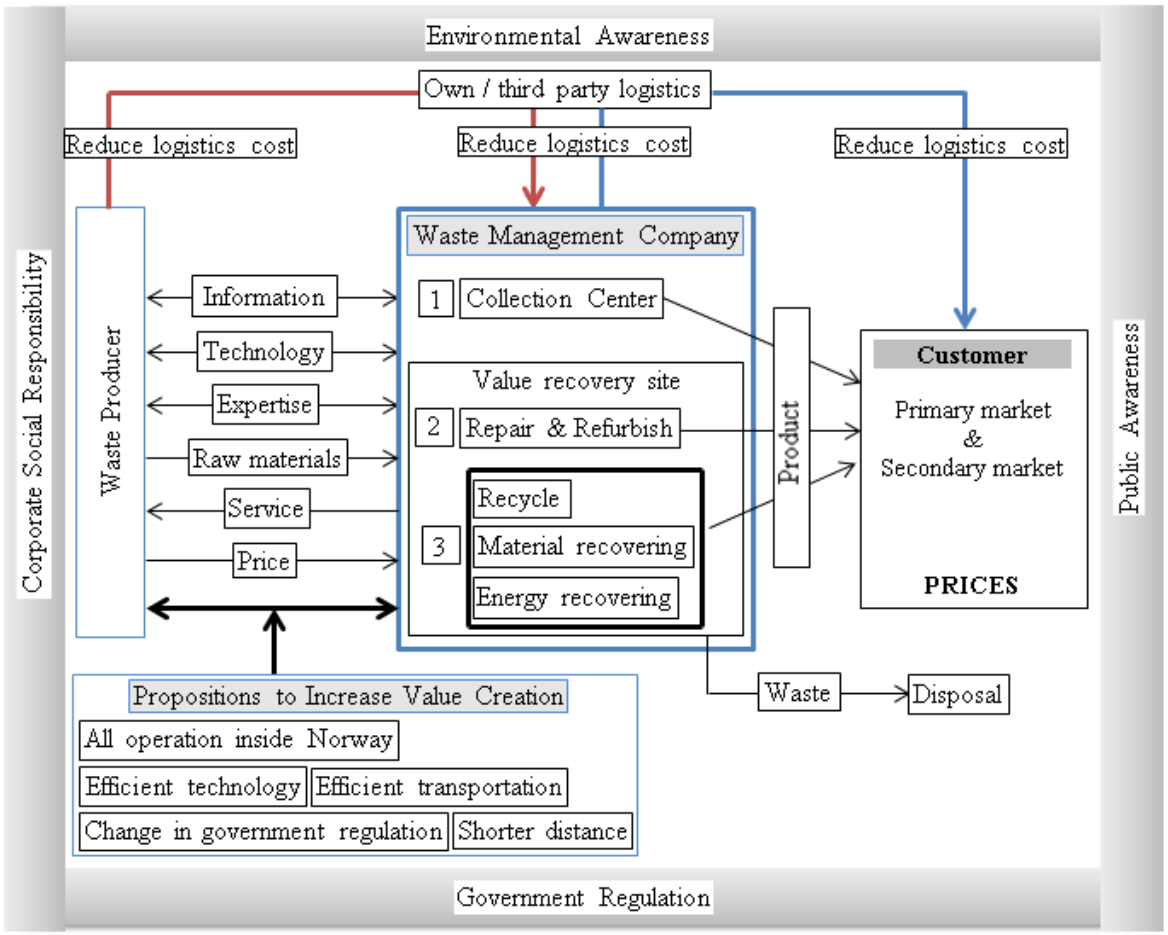


Figure 35: Suggested model in waste management from a customer value perspective.

The value creation model shows how higher value can be created from waste management process. This model has been developed based on the empirical findings and backed by the theoretical understandings developed from the literature reviews.

Relationship of parties in waste supply chain: The study reveals that all the parties in the waste management process are closely interrelated to each other like any other supply chain management. The waste from waste producer is considered as the raw materials for further production. Waste management company sells services to waste producer to take the responsibility of the waste. As the waste producer is the buyer of service, it pays to the waste management company. Moreover, both the waste producer and waste management company shares information, technology and expertise to ensure safe and proper process of waste. Waste producer also monitor and inspects waste management company to safeguard safe use or disposal of wastes. In addition, together the waste producer and waste management company are concerned about the public awareness regarding environment and human health.

Roles of waste management company: The waste management company plays the key role to increase value creation from waste. Like the ownership theory discussed by Pongcraz (2002), after taking responsibility of waste the waste management company becomes the new owner of waste. Most of the value creation activities happen at this stage. Based on the proposed model waste management company should divide the task into three stages. These three stages are developed to avoid any further treatment by other parties Therefore, any waste does not need to ship to other places for further treatment.

Among the three steps, the first step is to build up a collection center. This collection center can sort the waste that can segment which waste can be sold directly and which are needed to forward to the recovery site for further treatment. The wastes which can be sold directly are sent to the consumer market. The value recovery site has two different facilities. First, it has repair and refurbishes facility. In this plant the wastes which can be repaired and refurbished for reusing, should be repaired and refurbished. The products created out of repairing and refurbishing, are sent to the consumer market.

Furthermore, the second facility in the value recovery site includes recycling, material recovery and energy recovery. In this plant the rest of the wastes, after reusing, repairing and refurbishing, are recycled and burned to create new product, material and energy recovery. The new product, material and energy are sold to the consumer market once again.

At the last stage some of the wastes which cannot be recycled any more are considered as waste. Similar to the ownership theory, the current owner (waste management company) is unable to use this waste any more or not willing to use any more due to monetary loss or lack of technological advancement. This waste is disposed in a convenient location to avoid extra transportation cost. Respondents agreed that technical advancement can reduce the disposition rate of waste. Similar to the empirical findings, theoretically Muir (2010) argued that a few decades ago it was unthinkable to create different energy sources from everyday waste. Therefore, technological advancement can reduce the disposition rate of waste which can help to maximize value.

Influencing factors: There are four influencing factors considered for the model. The influencing factors are corporate social responsibility, government regulation, environmental awareness and public awareness. The waste producer has corporate social responsibility for proper management of waste that can help company to create good will and positive reputation. Besides corporate social responsibility, it is an obligation imposed by government for the waste producer to clean up the waste. Moreover, waste producer should also be concerned about clean and green environment.

The waste management company is influenced by both government and waste producer. The waste producer influences waste management company because they pay for cleaning up the waste. Government has predefined regulation for the waste management company that how to treat the waste to recover value. Moreover, the waste management company is also influenced by final consumer. Final consumers are concerned about the environmental cleanliness, which can be called as public awareness.

Barriers to increase value creation: The empirical findings reveal that there are barriers to increase value creation from waste management. These barriers are transporting waste outside Norway, Lack of advanced and efficient technology, lack of efficient transportation, strict government regulation and long distance transportation inside Norway. To increase value waste producer, waste management company and government should work together.

Similarly, some of the respondents openly expressed their opinion that due to strict government regulation they need to ship small amount of waste outside Norway. Sometimes, the return from this small amount of waste shipment is lower than the transportation cost. Government should relax the regulation up to an extent that can allow waste management company to treat all types of waste inside Norway. However, the flexibility in regulation should be fixed without compromising the environmental factors that influence human health and environment.

Moreover, the empirical study exposes that the technology used for current waste management process in Norway needs to be more advanced and efficient. Respondents stated that the technology needs to be more advanced and efficient like Germany. It is a

matter of fact that installing latest technology needs extra cost. However, to be successful in the long run it is vital to set up latest and advanced technology.

In addition, inefficient transportation is another barrier to maximize value from waste. Respondents acknowledged that the efficiency in transportation needs to be improved. As mentioned earlier that Munsami (2011) shows that lower transportation cost can maximize return on assets. To lower the transportation cost the efficient transportation system is a must. Sometimes, transportation cost depends on the third part logistics strategy. Both the waste producer and waste management company should analyze the strategy whether to use third party logistics for waste transportation. Re-scheduling and using hybrid vehicle can also help to reduce transportation cost.

Furthermore, the long distance transportation inside Norway is also a barrier to maximize value from waste. It is recommended earlier in section 5.4.1 that waste management company should have their own waste treatment machineries and equipment in a convenient location to avoid extra transportation. The study reveals that the extra transportation requires extra personnel, fuel, time consumption, insurance, vehicle maintenance and uncertainty etc. To avoid these extra costs waste management company can establish their own processing facilities in suitable locations. Again, it is a costly issue, but, evident in the empirical findings, in the long run it can help actors in waste management process to recapture maximum value.

5.7.1 Expected paybacks

The new value creation model (figure 35) is developed to overcome the challenges and barriers found in the empirical investigation. Therefore, it is expected that the new model may help to create value in the waste management process at Vestbase as well as all the actors in the waste supply chain. The expected benefits of the new value creation model to the process cannot be overestimated:

Environmental paybacks: The environmental benefits designate the possible favorable effects caused by the practice of the value creation model in waste management. There may have certain environmental benefits of the new value creation model-

- Reduces pollution and energy consumption associated with the manufacture of new materials.
- Recycling hazardous waste can help to reduce air, water, and soil pollution associated with extraction, refining and handling of raw materials.
- Recycling reduces emissions of greenhouse gases (GHG).
- Recycling process of hazardous waste need less energy to extract, transport, process raw materials and manufacture products.

Financial paybacks: The financial benefits indicate the benefit quantifiable in terms of money, such as revenue, net cash flow or net income etc. The financial/economic benefits include-

- Creates new source of revenue through re-selling, re-using and recycling.
- Reduces the cost of purchasing new materials by re-using.
- Reduces waste disposal costs.
- Improves work efficiencies through precise complete design.
- Reduces logistical distance; consequently it can reduce the total logistical cost.

Social paybacks: Social benefits of waste management indicate the increase of welfare of a society that can be derived from practice of the value creation model in waste management. It includes-

- Minimizes the effect of hazardous or wastes.
- Increases public awareness.
- Fulfills government/environmental obligations.
- Creates positive image of the actors by responsible corporate social responsibility.
- The businesses can create a “Green Image”.

Inter-organizational paybacks: Inter-organizational benefits refer to the way all the parties in the waste management network manage their relationships between one another and their clients or customers. It includes-

- Increases co-ordination and sharing of information, technology, knowledge, expertise between firms.
- Builds trust.
- Reduces switching cost.
- Increases comparative efficiency of each firm in the supply china, which helps other to increase internal efficiency to match with the inter-organizational efficiency.
- Increases healthy competition between waste producers and waste management company to ensure well-organized solution so waste.

5.8 Implications of the study

The new definition of waste, waste management and value creation model from waste management has certain implications. The implications are discussed in respect with both theoretical and managerial perspectives.

Theoretical implications: When looking at theoretical implications, researchers should probably notice that although the proposed model was not justified by measurable units, the model still account for a large portion of antecedents of value creation from waste management.

In addition, this study is somewhat different from the accepted and traditional belief or practice of waste management. In academic perspective this study will contribute to improve theory in WM by integrating it with RL and customer value approach from a SCM perspective with focus on inter-organizational integration.

Moreover, the theoretical contribution of RL process is still relatively new in scientific publication. Comparing to traditional logistics practices, theories on reverse logistics are still lacking. How the waste collection and transportation process is integrated into reverse logistics process is a topic would draw most academicians' attention. The finding of this study theoretically suggested that the efficiency of reverse logistics activities can help to increase value creation in waste management.

Furthermore, theoretically, developing value creation theories in waste management, the logistics and the transaction of waste from one owner to another can be integrated into the

concept of production and exchange economy. Since, purchasing takes place in the waste management process, the production economy perspectives can be integrated in the purchasing theory to focus on more revenue generation in the supply chain of waste.

Similarly, the transaction process of waste materials into reverse logistics process is a topic has not drawn most academicians' attention. This study shows that the transaction process of waste can be seen as exchange economy. Therefore, the concept of exchange economy in the waste management process can help to build new theory of value creation from waste management.

Managerial implications: From initial inquiry with business it seems that industry has already clearly understood the value that lies in WM. Therefore, in managerial perspective this study seeks to provide a fresh and provocative view of waste as a source of value rather than simply "garbage" and costs.

Similarly, businesses should consider, any object, which acquires a new owner, who wishes to take responsibility for it, is not a waste. This study can work as a guideline that management role is important in relation to handling waste, which ensures the value creation from waste.

The waste producers and the manufacturing companies have certain responsibilities and implication relevant to this study. Relevant manufacturing industry can reduce their resource use as well as to recall, for recycling, waste materials which result from their products. Therefore, it can ensure value creation from waste management.

Moreover, this exploratory study will hopefully raise awareness and consciousness to the managers about this topic, giving some guidelines about waste prevention, waste handling and value of waste in relation to logistics.

6.0 Chapter Six: Conclusion, Recommendations, Limitations and Further Research

6.1 Conclusion

This chapter highlights conclusion and provides certain recommendations, based on the findings of the study, for managers and academic researchers who excel in waste management. In addition, this chapter remarks limitations of the study which leads to the suggestions for further research.

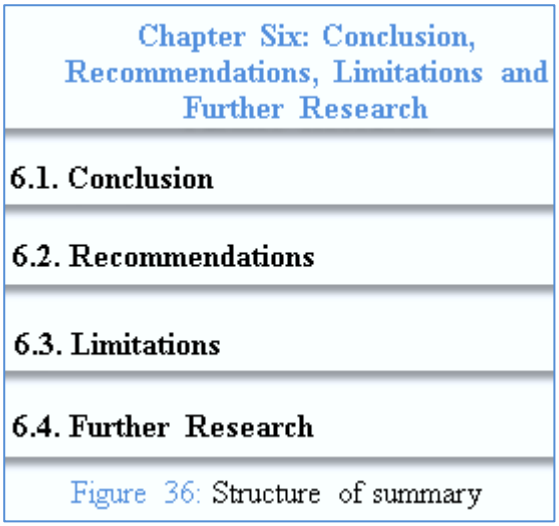


Figure 36: Structure of summary

The research plan of this paper was empirical. Therefore, the study was a real life case, with the goal of suggesting possible improvements. The study was conducted regarding Vestbase's waste and its management process in a WM network. The author knew that this was going to be challenging, based on the limited prescience knowledge about offshore waste management process. During the research, the author searched for relevant theories that emphasized research credibility. Therefore, the conclusion discusses if the outcome of this thesis is in accordance with what the author wanted to accomplish. It starts off by discussing the outcome of the research questions whether or not the author has met the research objectives.

The objectives of this study were stated by four research questions. The research questions are linked to each other, meaning that solving the first research question, gives the presumption to solve the next and so forth, in accordance with the exploratory research design.

The first research question was to describe *what are the types of waste handled at Vestbase?* This research question was purely technical. It pursued to evoke and helped classify different types of waste. This was the foundation for further research and analysis. In chapter 4, it was fully described what the types of wastes are handled at Vestbase.

The main finding was that there are four major types of wastes handled at Vestbase. They are industrial, bulk, metal, and hazardous wastes. Each of this type of waste was further divided into several fractions, which was described in the empirical findings and data analysis chapter. Therefore, the author claims to have fully described the first research question where the description of waste was detailed enough to get sufficient understanding of Vestbase's waste.

The second research question was to describe *how these forms of waste are managed?* This question seeks to evoke features of WM at Vestbase. These sets focused on organizing factors regarding waste. Chapter 4 described the details of waste management at Vestbase which was explicitly discussed in chapter 5. The obvious waste management process was pictured through figures 23 and 28.

The findings of the current state of waste management at Vestbase revealed that the waste management happens in several stages and there are several parties involved in this network. Shell is the waste producer and NG, MWM are the waste processors located on the base of Vestbase. Shell ships the wastes to Vestbase through waste ships and these wastes are taken care of by NG and MWM, where Vestbase provides technical and base services. Neither NG nor MWM treat any waste on the base, except bulk water is refined in the treatment plant of NG's own facility established on the base area.

The waste materials which can be re-used are sorted by NG at the base area and sent for re-using. Other types of wastes are then transported to downstream solutions for recycling, energy recover and safe disposal. The downstream parties are located both inside and outside Norway. Therefore, author believes to have thoroughly explained the second research question where the explanation of waste management was detailed enough to get adequate understanding of Vestbase's waste management.

The third research question was to explore *what characterizes the RL processes of the types of waste managed through Vestbase?* This question aimed to develop understanding how this managed waste may be interpreted as 'reverse logistics'. This involved importantly how waste was transformed through a flow thereby created value. Figures 24 and 29 in chapters 4 and 5 respectively showed and discussed the entire logistics process of waste management.

The findings of the RL process at Vestbase's WM exposed that RL is heavily integrated into the WM process. The empirical data showed that integration and involvement of logistics has significant effect on the performance of the waste management process. However, due to the governmental regulation some of the wastes, for example, high toxic hazardous waste, are sent out of Norway for further treatment. This extra transportation causes higher logistical cost. To improve logistics efficiency, reduce logistics cost and increase value creation a proposed model is developed, which is shown in figure 29.

The model suggests that all the waste processing activities should be accomplished inside the waste management company in an in-house production facility. By applying this strategy no waste needs to be shipped to any further downstream parties for treatment. In addition, the model suggested not shipping any waste out of Norway for treatment purpose. Together both of these strategies can help to reduce logistics cost. All these propositions are established based on empirical investigation and backed by relevant theories. Therefore, the author claims to have fully described the third research question where the description of integration of RL into WM was detailed enough to get sufficient understanding of characteristics of the RL processes of the types of waste managed through Vestbase.

The fourth and last research question was to describe *how these wastes, along with RL processes, create value in the WM network?* This question was set based on a developed understanding from analysis directed by the three preceding research questions, an overall understanding is sought as to how the management and transformation of waste, viewed as a SCM system, is associated with "value" from a customer perspective.

Figure 25 in chapter 4 showed the value creation from waste in waste management network at Vestbase in an empirical perspective. Additionally, figures 31 and 32 differentiate the tradition and current relationship of buyer and seller in a waste management viewpoint. Figure 34 presented how and what value emerges in waste management. Furthermore, figure 35 displayed the suggested model in waste management from a customer value perspective.

The findings of these models proved that value creation exists in waste management network at Vestbase. In addition, figures 31 and 32 verified the differences between the traditional buying and selling and relationship of parties in waste supply chain. In the traditional supply chain, customer receives the product in return of financial means. However, in the waste supply chain customer (waste producer/Shell) does not receive the product rather it pays for getting rid of the waste (raw materials for further production). Nonetheless, the Shell (customer) receives services from the waste collection and transportation company (NG). This trend was not discussed in any of the existing literatures so far reviewed. Therefore, an innovative contribution of the study was to clearly define and describe the relationships of the parties in the waste flow.

Moreover, there were influencing factors and barriers observed in increase of value creation from WM at Vestbase. The influencing factors were corporate social responsibility, government regulation, environmental awareness and public awareness. The barriers are transporting waste outside Norway, lack of advanced and efficient technology, lack of efficient transportation, strict government regulation and long distance transportation inside Norway. Considering these factors and barriers, the proposed model showed how the barriers could be overcome to increase value creation. Therefore, the author believes to have thoroughly explained the fourth research question where the explanation of value creation from waste management in a customer perspective was detailed enough to get adequate understanding about the value creation process of Vestbase's waste management.

As a final point, the building blocks query of this study was to explore *does waste really mean waste?* Based on all the analysis and discussion author provides new understandings of waste management, which can help reduce the production of waste and can ensure increase of value creation from waste management:

> *"Waste management is the reduction of production of waste materials to protect human health and environment; and efficient collection, transportation, recovery and disposal for the purpose of re-capturing value of materials originally defined as waste"*

The definition of waste management helps to understand waste management as a process of resource management. It was described in the analysis and discussion chapter how the waste serves its purpose as a raw material in the waste supply chain. Based on the empirical investigation the author argued that the traditional definition of waste was not consistent with the value creation activities. The current argument in favor of waste, to prove waste is not waste, is backed by number of well-known concepts developed by many waste management scientists and backed by the empirical investigation. By the new definition the author claims that waste is a human concept, and it further said:

> *"Waste is a human concept where its value is ignored by its owner, depending on either it cannot perform with respect to its original purpose, or the owner decide not to use it anymore"*

To end with, the determination of this study was to complement the previous research conducted by many waste management scientists. At the same time, this study offered an invitation to dialogue and to follow the author's perspective of viewing waste from a different standpoint, which was considered as a "valuable object". Therefore, the author claims to have fully described all the value creation activities from waste management and could see value in waste in relation with logistics and/or anything, simply because it is everywhere and it has value.

6.2 Recommendations for Vestbase

The recommendations are mainly related to how Vestbase and other actors involve in Vestbase's WM could increase higher value creation. These recommendations are set based on the triangulation of the interview data, observation, scientific journals. The recommendations for Vestbase cannot be overestimated because they are not verified by measurable units.

In-house waste processing by WM company: To increase value creation from waste, WM companies should have its own in-house waste processing facility. These activities can be set up into three steps. Among the three steps, the first step is to build up a collection center. This collection center can sort the waste that can segment which waste can be sold directly and which are needed to forward to the recovery site for further treatment.

The second facility in the value recovery site includes recycling, material recovery and energy recovery. In this plant, the rest of the wastes, after reusing, repairing and refurbishing, are recycled and burned to create new product, material and energy recovery.

At the last stage, some of the wastes which cannot be recycled are considered as waste. Similar to the ownership theory, the current owner (waste management company) is unable to use this waste any more or not willing to use any more due to monetary loss or lack of technological advancement. This waste is disposed in a convenient location to avoid extra transportation cost.

Establishing all waste processing facilities inside Norway: Due to strict government regulation, WM company needs to ship small amount of waste outside Norway. Sometimes, the return from this small amount of waste shipment is lower than the transportation cost. Government should relax the regulation up to an extent that can allow waste management company to treat all types of waste inside Norway. However, the flexibility in regulation should be fixed without compromising the environmental factors that influences human health and environment.

Installing latest and efficient technology: The empirical study exposed that the technology used for current waste management process in Norway needs to be more advanced and efficient. Respondents stated that the technology needs to be more advanced and efficient like Germany. It is a matter of fact that installing latest technology needs extra cost. However, to be successful in the long run it is vital to set up latest and advanced technology.

Reduce transportation distance: The long distance transportation inside Norway is another barrier to increase value creation from waste. It is recommended earlier in section 5.4.1 that waste management company should have their own waste treatment machineries and equipment in a convenient location to avoid extra transportation. The study revealed that the extra transportation requires extra personnel, fuel, time consumption, insurance, vehicle maintenance and uncertainty etc. To avoid these extra costs waste management company can establish their own processing facilities in suitable locations. Again, it is a

costly issue, but, evident in the empirical findings, in the long run it can help to recapture higher value.

6.3 Limitations

This study is an exploratory case study and conducted on Vestbase's waste management, which is an empirical problem. This was chosen because this field had no or little prior research. As a consequence of this, the research was conducted based on observations and interviews of key personnel of the focal firms involved Vestbase's waste management network. The interviewed key personnel were from onshore and offshore business. The author chosen to conduct 10 interviews based on data saturation strategy. There was no justification that how many interviews would provide more accurate and accepted outcome in the analysis. Therefore, the validity of the methodology along with data collection could be debated.

Additionally, the data was collected from waste producer (Shell), base service provider (Vestbase) and WM companies (NG and MWM). However, in the waste management process there are other parties involved in this network. No data was collected from the downstream parties due to the fact that these parties are located in a long distance inside Norway and some are located out of Norway. The information used regarding these parties were collected from Shell, Vestbase, NG and MWM, which was not justified by the corresponding actors. Therefore, the information regarding the downstream parties needs to be validated.

Similarly, one of the recommendations of this study indicated that government should relax the regulation up to an extent that can allows WM companies to treat all types of wastes inside Norway. Again, this recommendation was established based on the empirical data. Nevertheless, the author did not interview any environmental regulatory authority in Norway to justify this appeal, which was raised by WM companies.

The recommendations of this study for example, in-house waste processing by WM company, establishing all waste processing facility inside Norway, installing latest and efficient technology and reduce transportation distance are established based on the empirical data analysis. This data analysis has no clear mathematical justification to understand whether or not they actually fit in the real life context.

Moreover, all the recommendations to increase value creation from waste management were proposed considering the potential profit generation aspect. Nonetheless, the cost factor of the planning and implementations of the recommended strategies were not considered for this study.

Furthermore, this study is mainly is an empirical qualitative study. This means that the findings are not proved by measurable units. The recommendations are suggested based on the exploratory basis which has no concrete method of justification. Therefore, it is clear that if recommendations should reach the level of usefulness that the author intended, further research/tests has to be completed to see how the recommended solutions actually would work.

6.4 Further research

This section contains an overview of further research that can be carried out related to this thesis. The proposed value creation model in waste management is developed based on the data of one supply base related to the oil and gas industry in Norway. The similar research can be conducted on a larger scale to yield generalizable solutions in waste management, which can be applied in oil and gas industry in Norway.

Similarly, this study was a qualitative study and conducted on an exploratory basis. The results and recommendations are not justified by quantitative data. Therefore, a quantitative study is proposed to understand the relationship between waste management and value creation. Similarly, the sample size of this study was 10 and data was collected by interviews. In case of future quantitative study, the sample size should be large enough to represent the actual population in the oil and gas industry in Norway.

Moreover, the proposed value creation model in this study recommended certain measure to increase value creation. However, the cost and benefit analysis were not considered in the development of the proposed model. Therefore, the further research can be conducted considering the ROI to implement such proposed measures.

Furthermore, further research could also be done to find the impacts of logistics on waste management. It was found that logistics incurs a major portion of total waste management

cost. Therefore, the further study can be conducted on the impacts of logistics on value creation in waste management network.

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8.0 Appendices

8.1 Appendix A

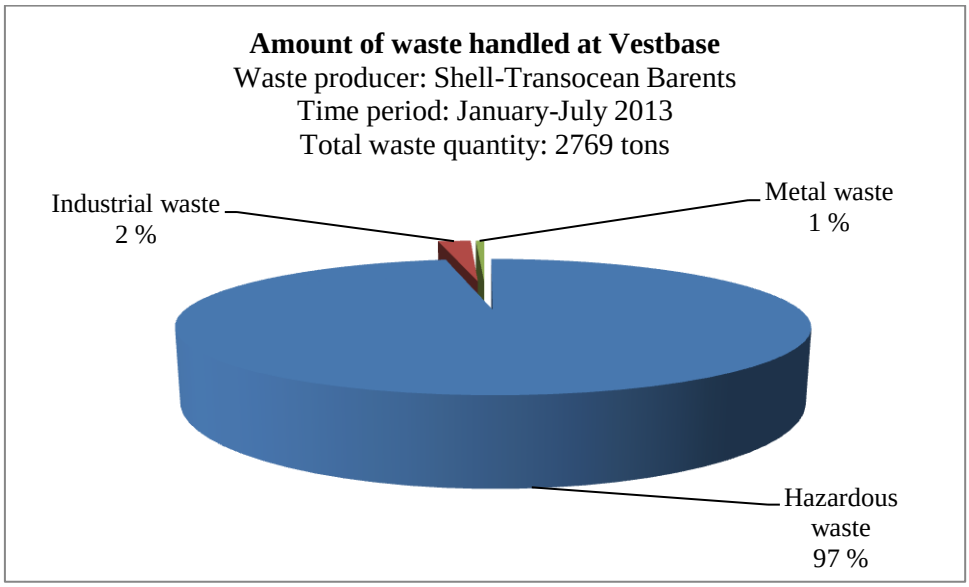


Chart 1: Amount of waste handled at Vestbase (major categories).

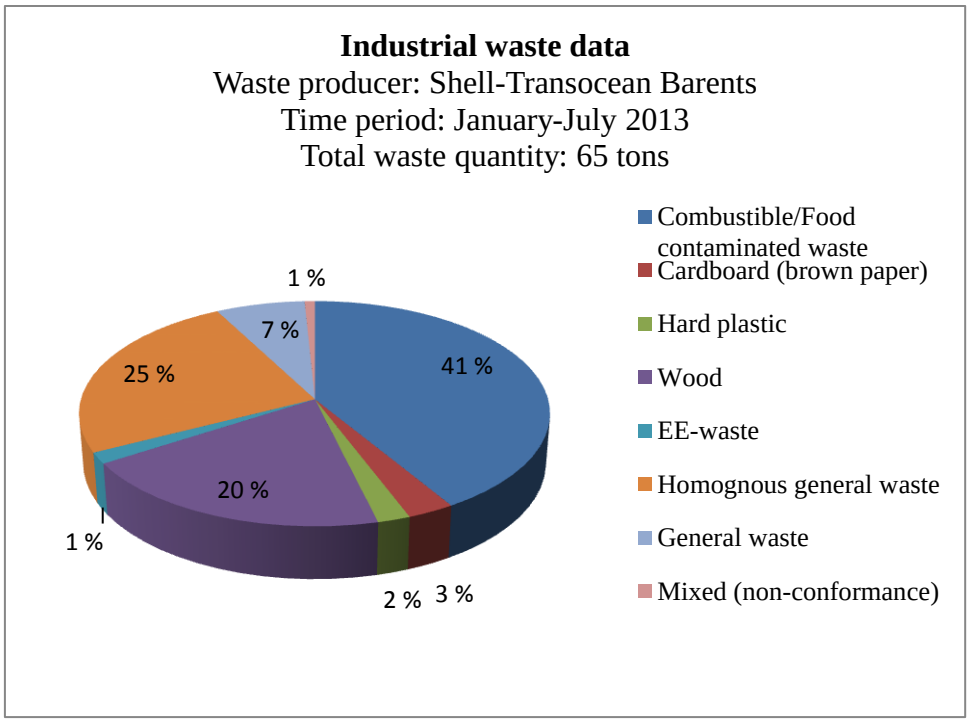


Chart 2: Amount of Industrial waste handled at Vestbase (major categories).

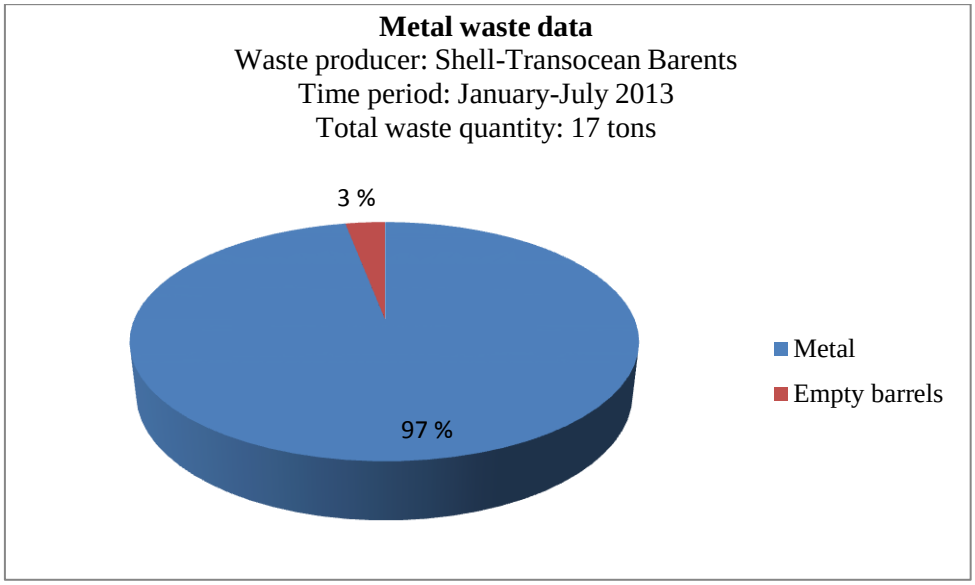


Chart 3: Amount of metal waste handled at Vestbase (major categories).

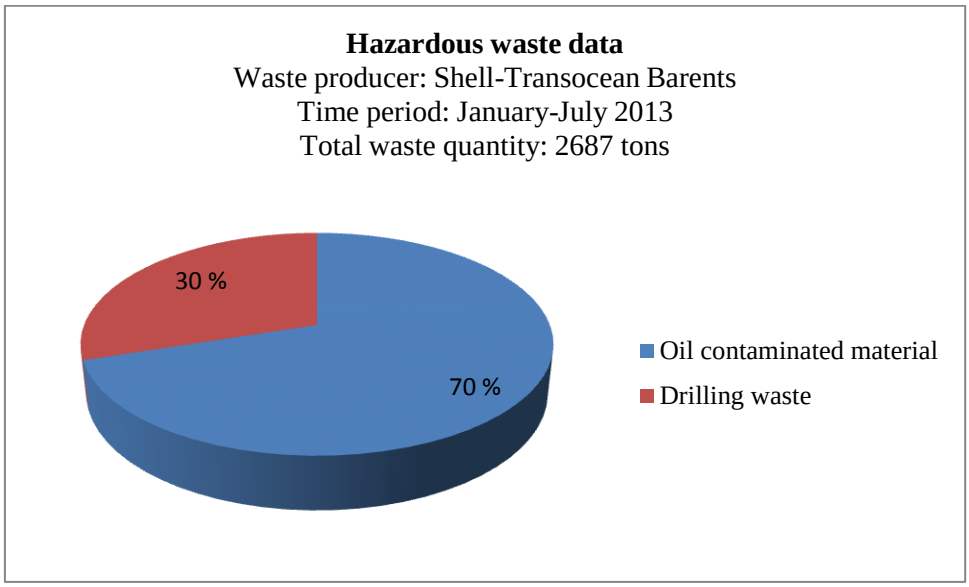


Chart 4: Amount of hazardous waste handled at Vestbase (major categories).

8.2 Appendix B

Table 1: Annex I - Categories of Waste (European Council, 1991).

Q 1	Production or consumption residues not otherwise specified below.
Q 2	Off-specification products.
Q 3	Products whose date for appropriate use has expired.
Q 4	Materials spilled, lost or having undergone other mishap including any materials, equipment, *etc.* contaminated as a result of the mishap.
Q 5	Materials contaminated or soiled as a result of planned actions, *e.g.* residues from cleaning operations, packing materials, containers, *etc.*
Q 6	Unusable parts *e.g.* reject batteries, exhausted catalyst, *etc.*
Q 7	Substances, which no longer perform satisfactorily, *e.g.*, contaminated acids, contaminated solvents, exhausted tempering salts, *etc.*
Q 8	Residue of industrial processes, *e.g.* slags, still bottom, *etc.*
Q 9	Residues from pollution abatement processes, *e.g.*, scrubber sludges, baghouse dusts, spent filters, *etc.*
Q 10	Machining/finishing residues *e.g.* lathe turnings, mill scales, *etc.*
Q 11	Residue from raw material extraction and processing, *e.g.* mining residues, oil filed slops, *etc.*
Q 12	Adulterated materials, *e.g.* oils contaminated with PCBs, *etc.*
Q 13	Any materials, substances or products whose use has been banned by law in the country of exportation.
Q 14	Products for which there is no further use, *e.g.* agriculture, household, office, commercial and shop discards, *etc.*
Q 15	Materials, substances or products resulting from remedial actions with respect to contaminated land.
Q 16	Any materials, substances or products which the generator or exporter declares to be wastes and which are not contained in the above categories.

Table 2: Shipping requirements of wastes from oil rigs to the base.

Name of waste	Requirements while shipping
General waste	Open waste container
Homogeneous general waste	Open waste container or in designated bag with specific type in closed container
Food waste	240 liters bin
Contaminated food waste	Collected in grey bag and sent on shore in 660 liters bin
Cardboard and brown paper	Pressed like balls and sent on shore in closed container.
Paper	Collected in 240 liters bin and sent in closed container. Container must be locked, which contains papers that need to be maculated.
Soft plastic	Pressed into balls, put into transparent bag and sent in closed container.
Hard plastic	Collected in transparent bag marked with hard plastic and transported in open or closed container.
Wood	Open waste container.
Metal	Open waste container.
Glass	240 liters white bins in closed container.
EE-waste	Marked or designated closed container.
Waste oil	Designated tanks and sent on board. Special barrels or opal barrels in closed containers.
Oil filter without metal sheath	Collected in opal barrels and sent on board supply ship.
Oil filter with metal sheath	Collected in opal barrels and sent on board supply ship.
Solvents	Opal barrels.
Paint unhardened	Opal barrels.
Liquid paint	Opal barrels.
Spray boxes	Opal barrels.
Acids	Special barrels or plastic cans.
Empty barrels and cans	Closed containers for dangerous goods.
Fluorescent tubes	Need to be packed so that they are not smashed and sent in designated closed containers.
Lead batteries	On pallets in container for dangerous goods or in closed containers.
Batteries	Sent in plastic containers or in opal barrels.
Oil based drilling liquid	Transported as bulk in tanks.
Oil based slops/oil emulations	Transported as bulk in tanks on supply chips or a transport tank ship.
Radioactive waste (LRW)	Transported in 120 liters special barrels.

Table 3: Sorting of industrial wastes and labeling with waste code and color code.

Industrial waste				
Name of the waste	**Waste code**	**Color code**	**Exceptions**	**Special remarks**
Wet organic waste	9100	Bio bags	None	None
Combustible/Food contaminated waste	9101	Grey bags	Textiles contaminates with oil	None
Paper	9203 or 9205	Blue bag	Littered or wet paper	None
Cardboard (brown paper)	9201	Blue bag	Littered or wet cardboard/brown paper	None
Soft plastic	9301	Transparent bag	Strongly littered plastic and plastic littered with dangerous fraction	None
Hard plastic	9303	Transparent bag	Plastic bottles with dangerous materials	None
Wood	9400	Yellow bag	Undamaged pallets	None
Glass	9600	White bag	Porcelain	None
EE-waste	9700	Brown bag	None	None
Medical waste	6000	Black, White, Red, Blue & Yellow bag	Lead contained medical waste	None
General waste	9000	Black bag	Textiles contaminates with oil	Includes toner caskets with special return procedure
Homogenous general waste	9002	White bag	Textiles contaminates with oil	None

Table 4: Sorting of metal wastes based on waste and color code.

Metal waste				
Name of the waste	**Waste code**	**Color code**	**Exceptions**	**Special remarks**
Metal	9500	Green bag	None	None
Misc. noble metals	9500	Green bag	None	None
Wire	9500	Green bag	None	Collide and bundled together
Cable waste	9500	Green bag	None	Collide and bundled together

Table 5: Sorting of hazardous wastes based on waste code, color code, ADR class, Packaging group and UN-no.

Hazardous waste				
Name of the waste	**Waste code**	**ADR class**	**Packaging group**	**UN-no.**
Batteries	7093	NO	NO	NO
Sandblast waste	NA	NA	NA	NA
Fluorescent tubes/light bulbs	7086	NO	NO	NO
Paint	7051	4.1 and 3	III and II	1325 and 1263
Oil contaminated materials	7022	4.1	III	1325
Spray cans/aerosols	NA	NA	NA	NA
Drilling waste	NA	NA	NA	NA
Chemicals/acids	7131	8	II	3264

Table 6: The classes of dangerous goods according to ADR

Class number	Substance/Article description
Class 1	Explosive substances and articles
Class 2	Gases
Class 3	Flammable liquids
Class 4.1	Flammable solids, self-reactive substances and solid desensitized explosives
Class 4.2	Substances liable to spontaneous combustion
Class 4.3	Substances which, in contact with water, emit flammable gases
Class 5.1	Oxidizing substances
Class 5.2	Organic peroxides
Class 6.1	Toxic substances
Class 6.2	Infectious substances
Class 7	Radioactive material
Class 8	Corrosive substances
Class 9	Miscellaneous dangerous substances and articles

Table 7: Packaging group of hazardous materials based on danger.

Packaging Group	Flash Point	Initial Boiling Point
I		≤ 35 °C (95 °F)
II	≤ 23 °C (73 °F)	> 35 °C (95 °F)
III	≥ 23 °C (73 °F) but ≤ 60.5 °C (141 °F)	> 35 °C (95 °F)

Table 8: European Council (1991) Annex IIB the re-use in the legislation.

R1	Solvent reclamation/regeneration.
R2	Recycling/reclamation of organic substances which are not used as solvents.
R3	Recycling/reclamation of metals and metal compounds.
R4	Recycling/reclamation of other inorganic materials.
R5	Regeneration of acids or bases.
R6	Recovery of components used for pollution abatement.
R7	Recovery of components from catalysts.
R8	Oil re-refining or other re-uses of oil.
R9	Use principally as a fuel or other means to generate energy.
R10	Spreading on land resulting in benefit to agriculture or ecological improvement, including composting and other biological transformation processes, except in the case of waste excluded under Article 2 (1) (b) (iii).
R11	Use of wastes obtained from any of the operations numbered R1 - R10.
R12	Exchange of wastes for submission to any of the operations numbered R1 - R11.
R13	Storage of materials intended for submission to any operation in this Annex, excluding temporary storage, pending collection, on the site where it is produced.

Table 9: European Council (1991) the waste directives of disposal operation.

D1	Tipping above or underground (*e.g.* landfill, *etc.*).
D2	Land treatment (*e.g.* biodegradation of liquid or sludge discards in soils, *etc.*).
D3	Deep injection (*e.g.* injection of pumpable discards into wells, salt domes or naturally occurring repositories, *etc.*).
D4	Surface impoundment (*e.g.* placement of liquid or sludge discards into pits, ponds or lagoons, *etc.*).
D5	Specially engineered landfill (*e.g.* placement into lined discrete cells, which are capped and isolated from one another and the environment, *etc.*).
D6	Release of solid waste into a water body except seas/oceans.
D7	Release into seas/oceans including seabed insertion.
D8	Biological treatment not specified elsewhere in this Annex which results in final compounds, which are disposed of by means of any of the operations in this Annex.
D9	Physico-chemical treatment not specified elsewhere in this Annex which results in final compounds that are disposed of by means of any of the operations in this Annex (*e.g.* drying).
D10	Incineration on land.
D11	Incineration at sea.
D12	Permanent storage (*e.g.* emplacement of containers in a mine, *etc.*).
D13	Blending or mixture prior to submission to any of the operations in this Annex.
D14	Repackaging prior to submission to any of the operations in this Annex.
D15	Storage pending any of the operations in this Annex, excluding temporary storage, pending collection, on the site where it is produced.

8.3 Appendix C

Table 10: Six sources of evidence: strengths and weaknesses (Yin, 2009, p. 102).

Sources of evidence	Strengths	Weaknesses
Documentation	• Stable – can be reviewed repeatedly • Unobtrusive – not created as a result of the case study • Exact – contains exact names, references, and details of an event • Broad coverage – long span of time, many events, and many settings	• Retrievability – can be low • Biased selectivity, if collection is incomplete • Reporting bias – reflects (unknown) bias of author • Access – may be deliberately blocked
Archival Records	• Same as for documentation • Precise and quantitative	• Same as for documentation • Accessibility due to privacy reasons
Interviews	• Targeted – focuses directly on case study topic • Insightful – provides perceived causal inferences	• Bias due to poorly constructed questions • Response bias • Inaccurate due to poor recall • Reflexivity – interviewee gives what interviewer wants to hear
Direct observations	• Reality – covers events in real time • Contextual – covers context of event	• Time-consuming • Selectivity – unless broad coverage • Reflexivity – event may proceed differently because it is being observed • Cost - hours needed by human observers
Participant observation	• Same as above • Insightful into interpersonal behavior and motives	• Same as above • Bias due to investigator's manipulation of events
Physical artifacts	• Insightful into cultural features • Insightful into technical operations	• Selectivity • Availability

Table 11: Table of contents of a protocol for conducting case studies (Yin, 2009, p. 68).

A. Introduction to the case study and purpose of protocol

- A1 Case study questions, hypotheses, and propositions
- A2 Theoretical framework for the case study (*reproduces the logic model*)
- A3 Role of protocol in guiding the case study investigator (*notes that the protocol is a standardized agenda for the investigator's line of inquiry*)

B. Data collection procedures

- B1 Names of sites to be visited, including contact persons
- B2 Data collection plan (*covers the calendar period for the site visits, the amount of time to be used for each visit, and the level of effort to do each case study*)
- B3 Expected preparation prior to site visits (*identifies specific documents to be reviewed and where they can be accessed*)

C. Outline of case study report

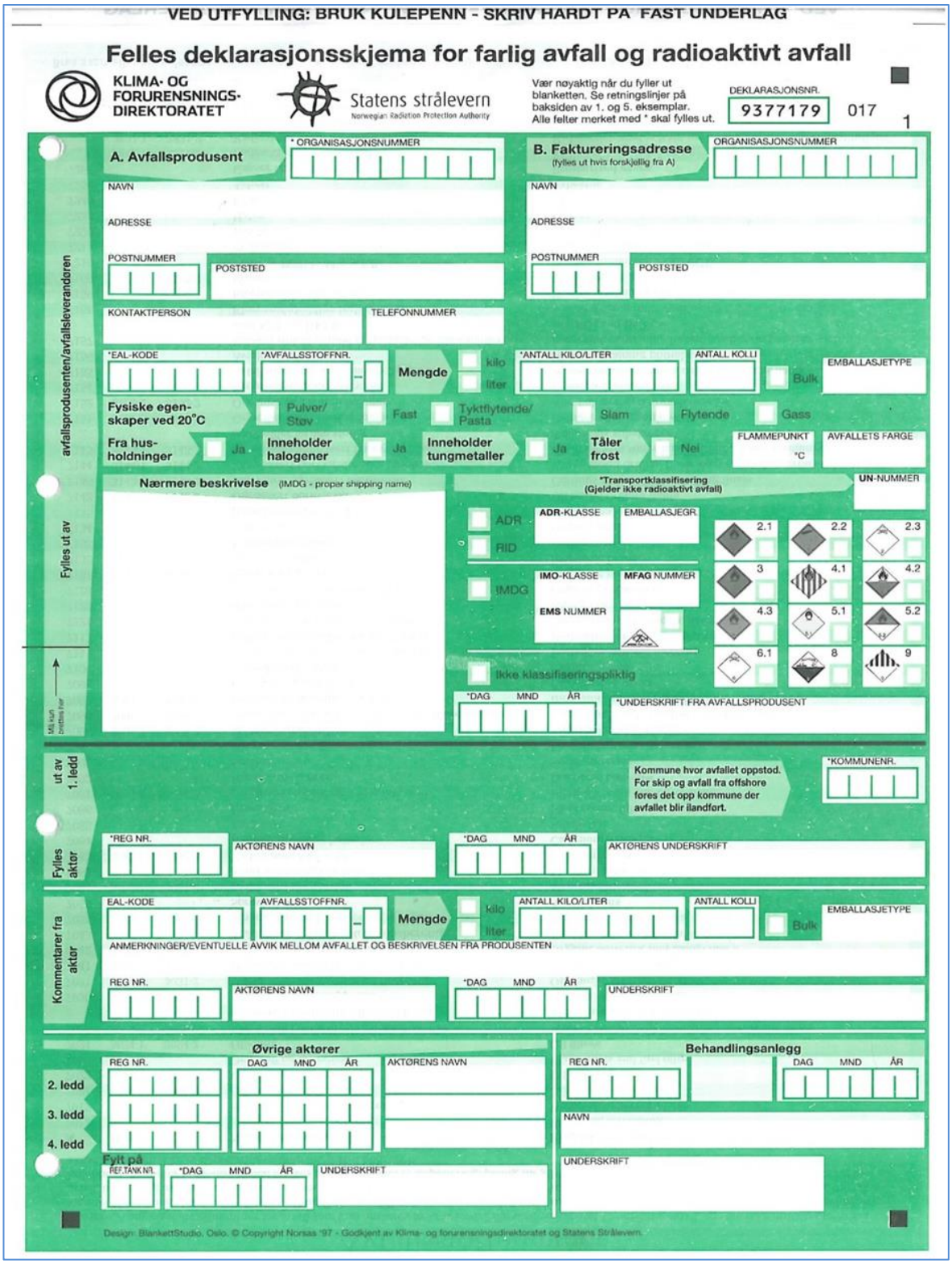
- C1 The practice in operation
- C2 Innovativeness of the practice
- C3 Outcomes from the practice, to date
- C4 Law enforcement agency context and history pertaining to the practice
- C5 Attachments: chronology, specific logic model for the practice, references to relevant documents, and list of persons interviewed

D. Case study questions

- D1 The practice in operation and its innovativeness:
  - a. Describe the practice in detail and the nature and amount of federal funding.
  - b. What is the nature, if any, of collaborative efforts across communities or jurisdictions that has been needed to put the practice into place?
  - c. How did the idea for the practice start?
  - d. Was there a planning process, and how did it work? What were the original goals and target populations or areas for the practice?
  - e. In what ways is the practice innovative, compared to other practices of the same kind or in the same jurisdiction?
  - f. Describe how the practice is to continue after federal funding has ended.
- D2 Evaluation
  - a. What is the design for evaluating the practice, and who is doing the evaluation?
  - b. What part of the evaluation has been implemented?
  - c. What are the outcome measures being used, and what outcomes have been identified to date?
  - d. What rival explanations have been identified and explored for attributing the outcomes to the investment of the federal funds?

8.4 Appendix D

Form 1: Decoration form of Norsk Gjenvinning for waste handling.



8.5 Interview Guide

1. Informant background Information
• Professional experience and education
• Time in position.
2. What are the types of waste handled at Vestbase?
• Types of waste
• Who are the waste producers
• Importance variation, risk, etc.
• Relation to processes on the platform
• Petroleum and non-petroleum
• Risks etc.
3. How is the waste materials handled at your company?
• Inbound, at Vestbase, outbound, between companies at Vestbase
• Own facility, equipment, or personnel to handle those wastes?
• Or contractual agreement with other companies?
• How are these contracts maintained?
• Differing challenges?
4. If these wastes are handled by other company, what is the business relationship?
5. How long-term are the contracts between Vestbase and companies handling waste?
• Spot market
• Relationships
• Stability
6. What are the challenges or obstacles handling waste?
7. Provide an overview of environmental, jilt and safety issues regarding waste handled at Vestbase?
• Environmental challenges past, present, future.
8. What is your opinion regarding governmental regulation regarding waste management?
• Is it working well?

- Should it be flexible?
- Should it be stricter?
- What is your opinion for better business profit margin? Etc.

9. Some waste is sent outside the country, what do they do with those waste?
10. Why don't you burn or process those waste inside the country?
11. Do you think you can avoid extra transportation cost by not sending send waste outside the country?
12. What is your suggestion to overcome those problems you mentioned?
13. What do you do with the waste (which has no reuse)? Do you just landfill them in a specific place or sell them?
14. How much percentages of materials are recovered from the processes?
15. How do you transport this waste?

- Vehicle types
- Transportation time
- Safety issues
- Transportation cost

16. What are the parties involved in the transportation process?
17. Could you please describe the network of transportation in the waste logistics process?
18. Please describe the network of companies involved in waste handling at Vestbase?

- Roles
- Size
- Importance
- Specialization
- Dynamics, processes

19. How much is degree of logistics integration in the WM flow?
20. How logistics performances influence value creation in the waste flow?
21. What are the obstacles do you face in case of waste logistics?
22. What is your suggestion to overcome from those problems you mentioned?
23. How can waste processes and management at Vestbase be improved?

- Both management and technical processes

- Efficiency – what is, how measured?
- Effectiveness – what is, how measured?

24. What is the value of waste?
    - Monetary
    - Non-monetary
    - Cooperative network of business relationship
25. Could you please mention the measurable and non-measurable aspects of value from waste?
26. Do you think more value can be recaptured from waste?
27. What are the potential ways to recapture values from waste?
28. The topic of the master thesis is "does waste really mean waste? An initiative to view waste as a value object in the reverse logistical process: An empirical analysis of Vestbase AS". What do you think how can value be captured from waste?
29. How profitable is this business? Any financial data if possible?
30. Does waste really mean waste?
31. What is your opinion about waste?
    - Is it a burden or an opportunity?
    - Does it occur only cost or give return too?
    - Or its just waste?
    - Or it is valuable? Etc.
32. Any statistical data for example, company records, annual report; waste handling statistics etc. regarding waste would be appreciated. If needed the researcher is ready to sign confidentiality agreement.
33. Could you please give me a tour to visit in the recycling plant and other activities
    - Take photos.
34. Concluding.
    - New informants, suggestions, specialists at Vestbase, other companies?
    - Interview same informant again? Asking for further information etc.