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Improving Environmental Information Exchange

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Master's thesis
December 2014

Master's Degree Programme in International Business Management
School of Business

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Kuvailulehti

Tekijä(t)	Julkaisun laji	Päivämäärä
Varakas, Riitta-Maija	Opinnäytetyö	08.12.2014
	Sivumäärä 81	Julkaisun kieli Englanti
		Verkkojulkaisulupa myönnetty: x

Työn nimi

Improving Environmental Information Exchange within Metsä Board Corporation

Koulutusohjelma
Master's Degree Programme in International Business Management

Työn ohjaaja(t)
Akpinar, Murat

Toimeksiantaja(t)
Metsä Board Corporation

Tiivistelmä

Tiedonvaihdon tärkeys on ymmärretty vasta hiljattain yrityksissä. Tiedonvaihto on keskeinen prosessi, jota yrityksen täytyy kehittää menestyäkseen. On tärkeää, että yritykset tunnistavat ja ymmärtävät, mitä tietoa ne tarvitsevat tukeakseen liiketoimintaansa ja varmistaakseen, että tieto tavoittaa oikeat henkilöt oikeaan aikaan. Kokonaisvaltainen lähestymistapa tietoon on välttämätöntä, koska tieto on riippuvainen ympäristöstä. Koska kaikki on yhteydessä kaikkeen, myöskään tietoa ei voi erottaa ympäristöstään.

Tutkimuksen päätavoite oli tutkia Metsä Boardin Suomen tehtaiden ympäristötiedonvaihdon rakennetta, kuinka sen eri osat tällä hetkellä toimivat ja kuinka se toimii kokonaisuutena. Tutkimus myös selvitti eri tapoja, kuinka parantaa nykyistä ympäristötiedonvaihtoa yrityksessä.

Tutkimusmenetelmäksi valittiin laadullinen tutkimus, koska haluttiin ymmärtää laajasti ja perusteellisesti tutkimuskohde. Toimintatutkimus valittiin metodologiaksi, koska se mahdollisti tutkimuksen tekijän mukanaolon henkilökohtaisesti tutkimustyössä. Käyttämällä toimintatukimusta yrityksen toimintamalleja voidaan parantaa toiminnan kautta ja teoreettinen tieto taas saavutetaan tutkimalla. Siten sekä toiminta että teoreettinen tieto lopulta hyödyttävät ihmisiä heidän jokapäiväisessä työssään. Teoreettisena runkona käytettiin Davenportin ekologista johtamismallia, jota Nardin ja O'Dayn tietoekologiat tukivat. Tutkimuksen luotettavuutta lisättiin käyttämällä erilaisia tiedonkeruumenetelmiä kuten haastatteluja, ympäristön tarkkailua ja dokumenttianalyysiä.

Saadut tulokset osoittivat, että tiedonvaihdon painopiste ei ole teknologiassa vaan ihmisten toiminnassa. Vaikka teknologialla on tärkeä rooli tiedonvaihdon kokonaisuudessa, se ei saa eikä sen pitäisi hallita yrityksen tiedonvaihtoa. Tutkimustulokset myös osoittivat useita parannuskohteita kuten kirjoitetun ja puhutun kielen oikeellisuus ja tarkkuus, tiedonvaihto projekteista, ympäristöasioiden käsittely kokouksissa, yleinen tietämys jätevesien käsittelystä, raportointi ja palautteen saanti. Tutkimuksessa on annettu parannusehdotuksia ja ehdotuksia keinoista, joilla toteuttaa ne. Tutkimus sisältää myös ehdotuksia tulevalle tutkimukselle. Uusi tutkimus voisi sisältää tiedonvaihdon ulkopuolisen vertailun, mikä varmasti tarjoaisi tärkeää tietoa tulevaisuuden kehitysprosesseihin.

Avainsanat (asiasanat)

Tiedonvaihto, ympäristötieto, tietoekologia, jätevesienkäsittelylaitos, suomalaiset kartonkitehtaat

Muut tiedot

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Description

Author(s)	Type of publication	Date
Varakas, Riitta-Maija	Master's Thesis	8.12.2014
	Pages 81	Language English
		Permission for web publication (X)

Title

Improving Environmental Information Exchange within the Metsä Board Corporation

Degree Programme

Master's Degree Programme in International Business Management

Tutor(s)

Akpinar, Murat

Assigned by

Metsä Board Corporation

Abstract

It is only recently that the importance of information exchange has been fully understood in organizations. Yet, it is a fundamental process that has to be developed in order for a company to succeed. It is important that companies identify and understand what information they need to support their business processes and ensure that it reaches the right people at the right time. A holistic approach to information is necessary since it is not independent of the environment as everything is connected to each other.

The main aim of the study was to examine Metsä Board Finnish mills' environmental information structure, how its different components currently operate and how it functions as a whole. The study also explored ways to improve the current environmental information exchange in the company.

A qualitative research method was chosen in order to gain a deeper understanding of the objective. Action research was selected as the methodology since it enabled the researcher to be personally involved in the process. By employing this methodology, the company practices can be improved through action and the theoretical knowledge gained through research, which will ultimately benefit the employees in their daily work. Davenport's ecological management approach was used as the main theoretical framework supported by Nardi's and O'Day's information ecologies. Data collection methods, such as environmental managers' interviews, observations and documentary analyses, were used to increase the reliability of the study.

The results show that the emphasis of information exchange is not on technology, but on human activities. While technology is an important part of business operations, it still does not and should not dominate a company's information exchange. The study also indicated that there are several areas for improvement such as the accuracy of written notes and spoken language, information exchange during projects, environmental issues in meetings and the overall know-how of the effluent treatment plants and reporting process. The thesis' proposes actions for improvement, and how to implement these actions including suggestions for future research through external benchmarking, which would provide important information for the future development of the processes.

Keywords

information exchange, environmental information, information ecology, effluent treatment plant, Finnish board mills

Miscellaneous

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1 INTRODUCTION

Information is power and power is the most fundamental process in society, since society is defined around values and institutions, and what is valued and institutionalized is defined by power relationship (Castells 2011, 10). Information drives our communication and our reactions to the entire environment. Information is vital to communication, and a critical resource of performing work in organizations. According to Sandkuhl (2007, 43), accurate and readily available information is a crucial basis for decision making, problem solving or performing knowledge-intensive work. The most important task is finding the right information, which can support the business process and work task.

It is essential to each and every company, whose target is to succeed in business to ensure that both internal and external information is the right information, which reaches the right people at the right time. To be able to recognize the right information organizations must identify and understand what information is needed. This is how organizations can support their business processes critical to their success. As Capurro (1989, 122) states, “information is power – for good, for bad”.

There is a wide range of different definitions of information. Drucker (1988, 4) accentuates that information is data endowed with relevance and purpose. Wang, Lee, Pipino and Strong (1998, 10) argue that information should be treated as a product. In a way Day (2001, 1) has a similar viewpoint, when he says that information has become a thing and not only that but also economically valuable thing. To exist, information needs data, without data there is no information. Data is commonly understood as raw data, which consists of symbols. Davenport (1997, 9) defines data as simple observations of states of the world meaning that data is easily structured, easily captured on machines, often qualified and easily transferred. When information is utilized knowledge will be created.

Nonaka (2002, 24) states that information is a flow, and knowledge is the stock. Information is the flow of messages, while knowledge is created by accumulating information. Hence, information is a necessary tool or material for achieving and constructing knowledge. Day's (2001, 120) definition is very much the same in stating that information is different from knowledge, it is the quality of being informed. According to Davenport (1997, 9), knowledge is information with the most value and is consequently the hardest form of information to manage. Knowledge is valuable information from the human mind that includes reflection, synthesis and context.

Data, information, and knowledge are very closely connected to each other and all of them are dependent on each other. A poor quality data impacts in many ways on information and knowledge. According to Redman (1998, 80), these impacts can include customer dissatisfaction, increased operational cost, less effective decision-making, and a reduced ability to make and execute strategy. Furthermore, as poor data quality decreases employees' job satisfaction, it also increases the mistrust that internal organizations may have in one another. Davenport (1997, 28) accentuates that a holistic approach to information is more than just to apply technology to information problems or turn data into something of use on computers. Information ecology includes tools, which can mobilize information strategy, politics, behavior, support staff, and work processes to create better information environments.

Scanning the external environment, rather than adapting to or molding it, matters most. Organizations should pay attentions, what information they need from external environment, and when the need of information need is clear they try to find right sources to get it. Processes, persons, and channels must be developed to pull the information inside the organization and integrate it into a usable form. (Davenport 1997, 210-212.)

The European Directive 2003/4/CE specifies what environmental information is. In Article 2, it specifies the purpose of the Directive as follows:
'Environmental information' shall mean any information in written, visual, electronic or any other material form on:
a) The state of the elements of the environment

b) Factors, such as substances, energy, noise, radiation or waste
c) Measures, such as policies, legislation, plans, programmes, environmental agreements and activities
d) Reports on the implementations of environmental legislation
e) Cost-benefit and other economic analyses and assumptions
f) The state of human health and safety, including the contamination of the food (2003, 27).
A principle purpose of the Directive is to provide access to information about our environment.

The main target of the study was to examine Metsä Board Finnish mills' environmental information structure, how its different components currently operate and how it functions as a whole. The study also explored ways to improve the current environmental information exchange in the company. A holistic approach to information is used in this study, since information is not independent of the environment as everything is connected to each other.

1.1 Information and Environment

As mentioned in the earlier chapter information is not independent of the environment. It is a part of everyone's life and it affects humans and organizations. Information environment can be studied as internal and external, but both of them interact with each other. Davenport (1997, 28) quotes ecologist Garrett Hardin stating that "You can never do just one thing", meaning that everything is connected.

Davenport (1997) introduced in 1997 a new way to look at information management, which takes into account the whole information environment of the organization. Davenport accentuates that information ecologies can mobilize information politics, strategy, behavior, support staff, and work processes and not only architectural designs and information technology (IT) to produce better information environment. (28-33.) Nardi and O'Day (1999) define that information ecology is a system of people, practices, values, and technologies in a particular local environment. In information ecologies, the

focus is not on technology, but on human activities that are served by technology. Furthermore, Nardi and O'Day emphasize that information ecology is marked by strong interrelationships and dependencies among its different parts. The parts may be different from each other, but they are closely bound together. (49-51.) Davenport (1997, 32) also states that information environment is very complex especially in big organizations. This opinion is supported by Nardi and O'Day (1999), saying that information ecology is a complex system of parts and relationships and it exhibits diversity and experiences continual evolution. (50-51.)

According to Davenport (1997, 29-33), information ecology includes the following four ecological attributes:

Integration of Diverse Types of Information

When biological ecologies thrive on species diversity, information ecologies thrive on information diversity.

Recognition of Evolutionary Change

It can be assumed that information ecologies constantly change meaning that information systems need to be flexible.

Emphasis on Observation and Description

Approaches to information management must become more descriptive. To understand the information requirements of organization mean a lot of work, because information environment in any large organization is highly complex.

Focus on People and Information Behavior

When focusing on people in the ecological management it involves providing information, observing what people are doing and first and moreover facilitating its effective use.

There are also three environments in Davenport's information ecology model. These environments are the external environment, the organizational environment, and the information environment. (Davenport 1997, 33-34.) The environments formulate

Davenport's ecological model for information management. The information environment is the core of an ecological management approach.

1.2 Introduction of the Company

Metsä Group's parent company, Metsäliitto Cooperative, has just celebrated its 80th anniversary on 23th January 2014. Metsäliitto Oy was established in 1934 to promote the sale of Finnish small-dimensioned wood. Since 1947, Metsäliitto Oy has been a cooperative (Metsä Group 2014). Metsä Board is one of the five daughter companies of Metsä Group (see Figure 1).

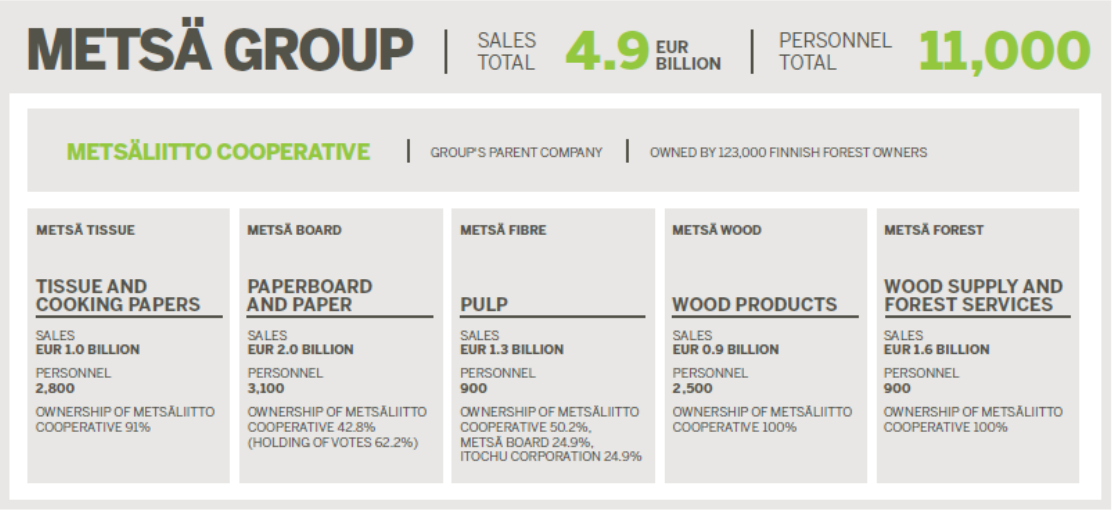

FIGURE 1. Metsä Group Structure (Metsä Group Annual Report 2013, 24)

Metsä Board is Europe's leading producer of fresh forest fibre cartonboards, the world's leading manufacturer of coated white-top kraftliner, and a major paper supplier. Metsä Board business is divided into two business areas: Cartonboard and Linerboard & Paper. Cartonboard business area produces cartonboard and graphic boards, which are used in packaging foodstuff, sweets, cigarettes, pharmaceuticals and cosmetics. Linerboard & Paper business area is the world's leading manufacturer of coated white-top kraftliner and added to this, it also produces uncoated white-top krafliner and uncoated fine paper. Krafliners are used in consumer, retail, self-ready packaging and point-of-sale solutions and uncoated fine paper is mainly for office end-users. (Metsä Board 2014.)

Metsä Board's main raw material is renewable and sustainably grown fresh forest fibre, the origin of which is always known. In Metsä Board also energy and material efficiency have a high priority. The company is a major user of biofuels and a large producer of bioenergy. (Metsä Board Annual Report 2012, 13.)

Metsä Board is listed on the NASDAQ OMX Helsinki and its total sales in 2012 were EUR 2.1 billion. It has approximately 3,300 employees and it is present in over 70 countries. The company has nine production units in three European countries. Figure 2 shows mills' locations in Europe.

FIGURE 2. Production Locations of Metsä Board 2014 (Metsä Board General Presentation 2014, 8)

All Metsä Board mills are ISO 14001 certified. The best available technology is used, where applicable and the mills are operating according to local environmental guidelines and standards. The company cuts out systematically emissions by improving its energy efficiency, increasing the use of bioenergy, and optimizing all transportations. (Metsä Board 2013.)

Metsä Board is committed to the principles of sustainability. It takes the economic, social and environmental impacts of all its operations into consideration. Sustainability

guides all Metsä Board's operations and it is the basis for the company's success. (Metsä Board Annual Report 2012, 13.)

Company's vision is to grow profitably, reaching an even stronger position as the world's leading supplier of high quality consumer packaging paperboards. Company's values are responsible profitability, reliability, cooperation and renewal.

1.3 The Current Working Model of Information Exchange at Metsä Board

The focus of this research was on Metsä Board's environmental information exchange and especially on effluent treatment area. The target was to develop information exchange and to give proposals for information improvements. To be able to do that, it was necessary first to clarify internal and external information exchange processes and responsibilities in company's units in Finland. The researched units in Finland were Metsä Board's mills Kaskinen, Kemi, Kyro, Simpele, Tako, Äänekoski and headquarters in Espoo. There were signals, which indicated that the current information exchange could be more efficient, it could be reached more people and it could be more transparent.

After a clear picture of environmental information exchange was received, the final target was to find the main actions for improvements, taking account of different parts of the process. Nardi and O'Day (1999) accentuate that information ecology is marked by strong interrelationship and dependencies among its different parts. These parts may be different from each other, but they are closely bound together. (p. 51.)

Hence, the aim of the study was also to enable the right environmental information to the right people at the right time, making sure that important information was not missing and unnecessary information was deleted and in the end the process itself was pleasant for all users.

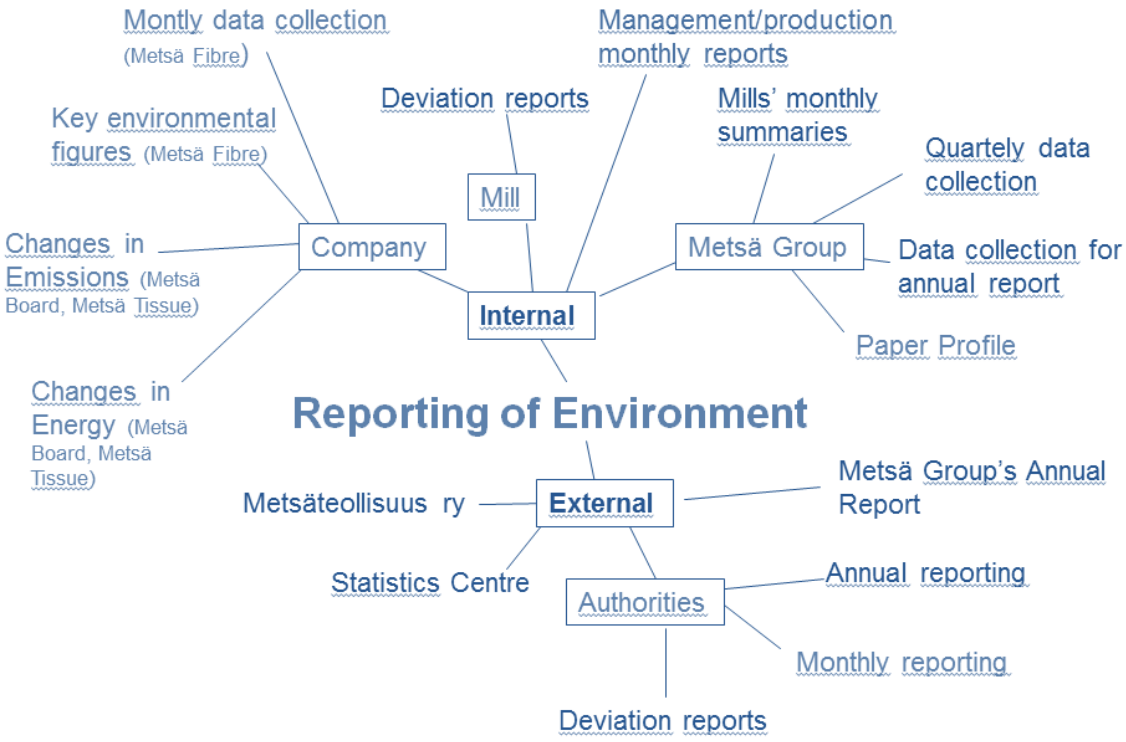

FIGURE 3. The Current Reporting of Environmental Information in Metsä Group (2013)

One of the most important issues, which came out in the beginning of the research, was environmental reporting. The environmental reporting has an important role in information exchange especially in big companies as in Metsä Board. The results of reporting are used in internally and externally. In addition, information of the reports should be right, it should reach right people at the right time and overall the process itself should be pleasant to all users.

Figure 3 shows different reports, which are prepared at Metsä Group for an internal and an external use. The figure shows, how fragmental reporting process is overall. Certain reports and statistics are functioning as barometers of decision-making for company's management. When planned improvements will be implemented, they will support Metsä Board's management decisions and organizational effectiveness. The implementation of improvements will also make reporting more pleasant for users. Information exchange effectiveness can be executed for instance by reducing overlap in reporting and facilitating cooperating. The implemented actions should strengthen the sustainable business practices.

Metsä Group has communication team, which works for all Metsä Groups companies. The team supports companies' business, strategy and corporate image by providing consistent and planned solutions. (Metsä Group Communication 2013, 3.) Moreover, Metsä Board has its own communication function, which task is to manage company's own communication. The company emphasizes that the periodic and ongoing information must be timely, consistent, and credible, and it must be consistent with legal requirements. (Metsä Board Communication 2013.)

Sustainability is the basis of Metsä Board's success and its principles covering the whole value chain (Metsä Board Annual Report 2012, 13). Sustainable targets include business, economic, social and environmental responsibilities. Metsä Group's Executive Management Board is responsible for monitoring the enforcement and realization of these principles.

Since sustainability is the basis for the whole Metsä Group, it has specified its own Environmental Policy with guidelines. Every year Sustainability and Corporate Affairs of Metsä Group publish sustainability report, which includes detailed information about subject. Policy is applied globally in all companies and legal entities belonging to Metsä Group. These guidelines are as follows:

1. Everyone at Metsä Group shares responsibility for our environmental performance
2. We improve our environmental performance continuously
3. We utilize our production resources responsibly
4. We are committed to sustainable forest management
5. We expect our suppliers to follow a responsible environmental policy
6. We communicate transparency with our stakeholders
7. Environmental impacts are assessed. (Metsä Group Environmental Policy 2011, 1-2.)

All activities in the final are based on European Directive of environmental information.

Metsä Group's and Metsä Board's values emphasize responsible profitably, reliability, cooperation, and renewal unite all of its employees. Continuous improvement and development constitute the core of its operations. Clear responsibilities and goals

increase personnel's motivation and provide added value to the company. (Metsä Group and Metsä Board 2013).

Furthermore, there is twice a year an environmental meeting for all Finnish mills' environmental managers. In these meetings, all managers get together and are able to exchange views on environmental issues. There is also twice a year so called environmental responsibility meeting, which is organized at each mill. Some irregular meetings, where environmental matters are discussed, are also now and then.

1.4 Research Questions

It was obvious that environmental information exchange needed improvements at Metsä Board. First, the necessary actions had to be clarified and then implemented. The research questions are as follows:

- What actions need to be taken to improve the environmental information exchange at Metsä Board?

- How can these actions be implemented?

The environmental requirements of authorities and customers are increasing in all businesses and not just in the forest industry. The amount of information is also increasing and diversifying. How to handle the growing information flow is the core question in many companies including Metsä Board. Hopefully this study enables to raise new questions, but also gives the necessary answers about information exchange and especially about environmental information exchange.

1.5 Structure of the Research

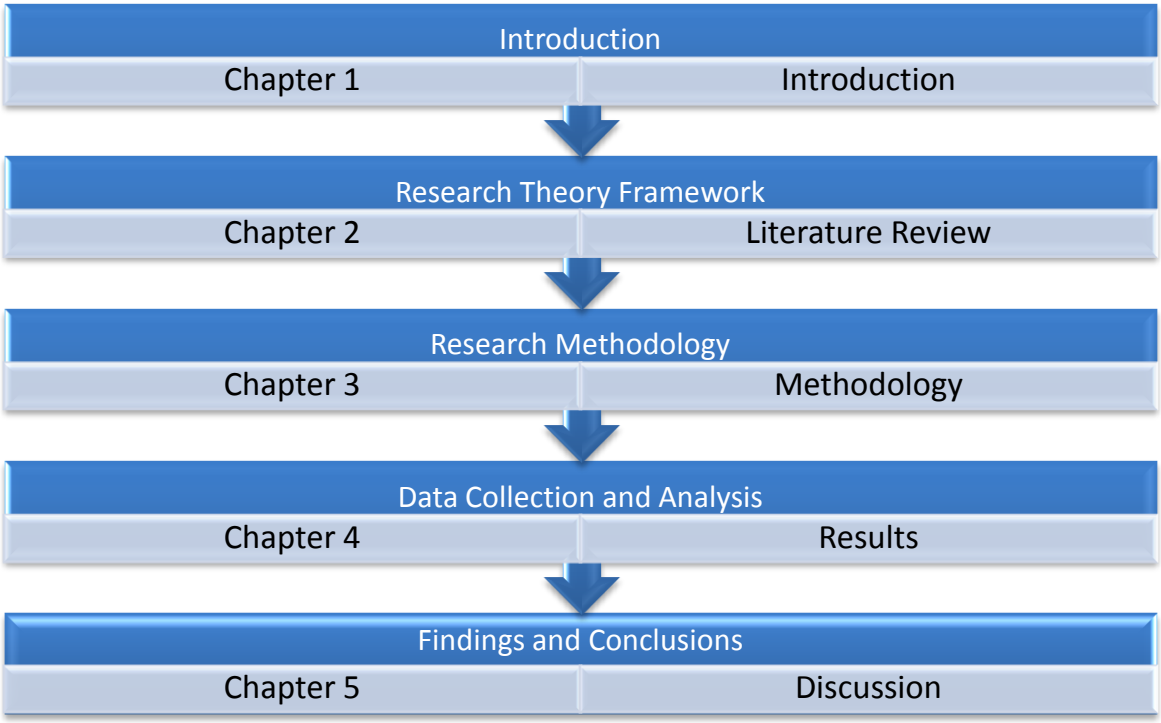

FIGURE 4. Structure of the Research

Chapter 1 focuses on definitions of information and different viewpoints of it. The connection between data, information, and knowledge is reviewed. The environment of information is studied along with Davenport's (1997, 34) ecological model for information management. Furthermore, Metsä Board is introduced and its current working model is presented.

Chapter 2 contains a literature review. Firstly, the meaning of data, information, and knowledge, and what especially distinguishes them from each other are explained. Secondly, information theory and the concept of information's origin are examined more closely through existing literature. A wide range of literature, studies, books, articles and web material are exploited in investigating and clarifying the meaning of information and the environment of information. The examined literature gave a good foundation for finding answers to the research questions. Davenport's 'The Information Ecology' is the basis of theoretical framework in this study. The environment of information encompasses the six most critical components of information ecology:

strategy, staff, culture/behavior, politics, architecture, and process (Davenport 1997, 34).

Chapter 3 describes the action research approach including data collection methods, data analysis and the research's evaluation of the validity and reliability of the study. Moreover, the development of the research is monitored at a more detailed level.

Chapter 4 focuses on the research results, which hopefully interest both the company's managers and those, who are interested in information in general. This research is also expected to give a clear picture of the structure of the company's current environmental information exchange, which helps to develop that area. The results are also expected to inspire the company to create new ideas and effective ways to handle environmental information.

Chapter 5 summarizes the main findings and final conclusions and how they answer the research questions. This chapter also presents suggestions for the future research.

2 LITERATURE REVIEW

This chapter presents a review of literature, which is related to the concept of information. Differences between data, information, knowledge and wisdom are clarified in this chapter. Figure 5 illustrates the data-information-knowledge-wisdom (DIKW) model. Furthermore, information theory, semiotics, semiotics framework, information flow together with information technology (IT) systems are described here. All these different information components in the information environment are related to each other and all of them affect organization's capability to operate.

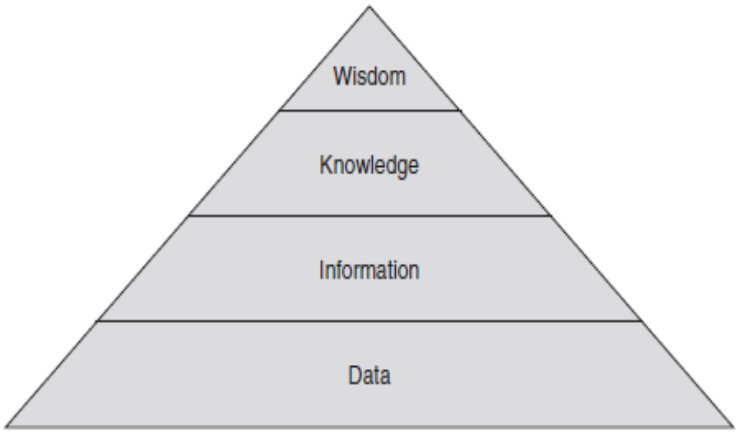

FIGURE 5. The DIKW Hierarchy (Rowley 2007, 164)

2.1 Data, Information, Knowledge and Wisdom

First, it is important to clarify, what information really means. It is quite common that the definitions of data, information, and knowledge are understood as a same thing. But there is a clear difference between their meanings. The traditional explanation is that data is raw material, facts, and figures like signs, text, words, numbers, symbols, and on their own they do not have meaning. To get meaningful information data has to be processed somehow. Ackoff asserts (1989, 4) that knowledge is know-how, for example, how a system works and how to control systems. Wisdom, which is located at the top of a hierarchy, is according to Ackoff a matter of using that practical know-how to achieve appropriate ends. Rowley (2007, 174) states that there is a consensus that data, information, and knowledge are to be defined in terms of one another, although data and information can both act as inputs to knowledge.

Davenport and Prusak (2000) emphasize that data, information, and knowledge are not interchangeable concepts. Data is a set of discrete, objective facts about events and it can be described as structured records of transactions. Data describes only a part of what happened: it provides no judgment or interpretation and no sustainable basis of action. There is no meaning in data, but it is important to organizations, because it is an essential raw material for the creation of information. Furthermore, they state that

knowledge derives from information as information derives from data. Knowledge is valuable, since it is closer than data or information to action. (1-6.)

According to Lundqvist (2007) the distinction between data, information, and knowledge is an elusive subject especially regarding to knowledge. Data and information are comparatively easy to aggregate, manage, and communicate by means of technology. Knowledge is not easy to deal with from an information system perspective because of individual factor existing in knowledge. (32-34.)

Polanyi's (1967, 108) argues that knowledge has to be divided into tacit and explicit knowledge. The tacit knowledge is highly personal and it is deeply rooted in an individual's actions and experience. Furthermore, it is expressed as insights, intuitions and hunches. The explicit knowledge is codified and objectified in a way that allows it to be transmitted between individuals in systematic way. It is also expressed as words or numbers.

Viewpoint of Takeuchi (2001, 319), is in line with Polanyi saying that there are two kinds of knowledge, explicit knowledge and tacit knowledge. The explicit knowledge can be expressed in words, and numbers and shards in the form of data, manuals, scientific formula and so forth. It can be readily transmitted to individuals formally and systematically. The tacit knowledge is highly personal and hard to formalize, making it difficult to communicate or share with others.

Nonaka states in the conversation with Scharmer (1996, 24-25) that information is the flow, and knowledge is the stock. Information is something passive and knowledge has to do with goodness, beauty and truth. (24-25.) Nonaka (1994, 15) also states that information is a flow of messages, while knowledge is created and organized by the very flow of information, anchored on the commitment and beliefs of its holder.

On the other hand Clarke and Rollo (2001, 33) define quite clear difference between data, information, and knowledge. They state that data is a set of discrete, objective facts presented out of context and without judgment or external interpretation. Data becomes information first, when it is analyzed, categorized, summarized, and put in a

context and thereby become intelligible to the recipient. Data relates to the actual bits and characters (as in information systems) or some other physical manifestation of communication. Data are usually arranged to provide some meaning to the observer, typically as text, images, etc. whereby the patterns and relationship in data is pointed out. Thus, information is created when data is endowed with relevant and purpose i.e. put in context. Knowledge can be seen as information that comes with insight, framed experience, intuition, judgment, and value. In some sense, knowledge represents truth and does as such offer a reliable basis for action. Knowledge is the body of understanding and skills and is increased through interaction with information.

2.2 Information Theory

The first information theory was primarily developed by Claude Shannon and his colleagues at Bell Labs in the 1940s (Figure 6). The theory is one of the few ones in the scientific fields, which has an identifiable beginning. Shannon's "A Mathematical Theory of Communication", which was published in the Bell Systems Technical Journal in 1948 was targeted only to communication engineers. But mathematician Warren Weaver thought that this should reach a wider audience than just people in the field, so Weaver published in 1949 "Recent Contributions to the Mathematical Theory of Communication". According to Weaver (1949) information must not be confused with meaning. The word information in communication theory relates not so much to what you *do* say, as to what you *could* say. Information is a measure of one's freedom of choice when one selects a message. (99-100.)

The work of mathematician Claude Shannon is considered to be the most influential work in the field of information theory (McEliece 2002, 13). McEliece wrote:

> *"While of course Shannon was not working in a vacuum in the 1940s, his results were so breathtakingly original that even the communication specialists of the day were at a loss to understand their significance. It became clear that he had created a brand-new science, and the others began to make first-rate contributions of their own".*

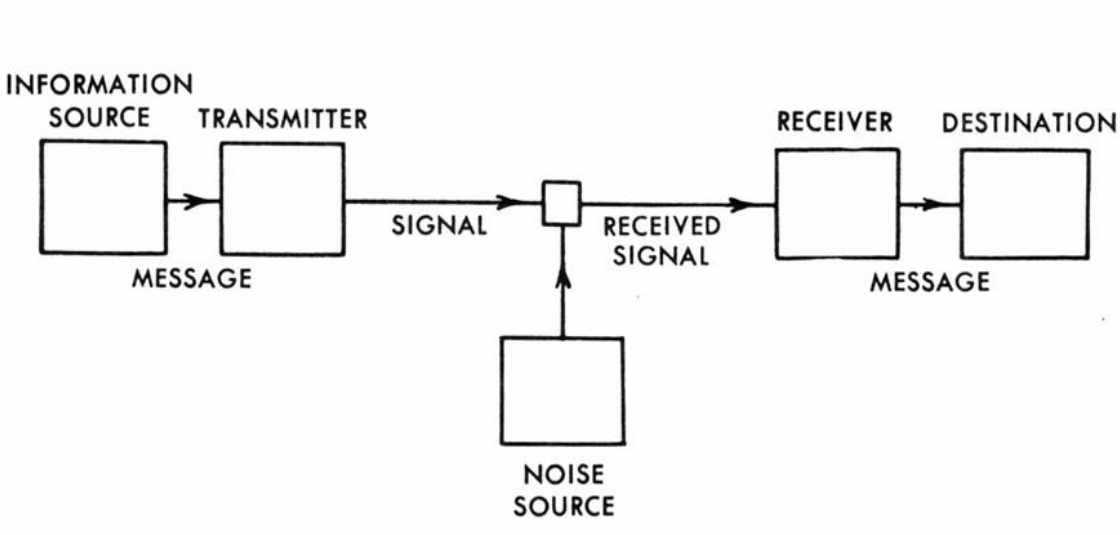

FIGURE 6. Schematic Diagram of a General Communication System (Shannon 1949, 5)

Shannon (1945, 31) said that the semantic aspects of communication are irrelevant to the engineering problem and this notion is supported by Dretske (1981, 41). According to Dretske (1981, 40) a genuine theory of information would be a theory about the content of our message, not a theory about the form in which this content is embodied.

James Gleick (2011, 8) writes in his book 'The Information' that Shannon's theory made a bridge between information and uncertainly, between information and chaos. Information is what our world runs on: the blood and the fuel, vital principle.

As for Claude Shannon communication meant only a matter of sending a message, in the 1970's information and communication started raising a bigger interest, which was a consequence of computers and IT. At the moment information is coming from all directions to leave us all overwhelmed. Information is developed into different fields like information logistics, information management, information technology, information science and information knowledge.

2.3 Semiotics and Semiotics Framework

It is very difficult to give a definition, what information really is. A typical answer is that information is a processed data that has meaning to its users. But then another

question arises in: “What is meaning?” According to Liu (2000, 1) to be able to understand the nature of information, one may have to find some fundamental and primitive notions with which the question can be investigated and explained. The concept of a sign is such a primitive notion. Signs are carried in information one way or another.

Semiotics is the study of signs, where “a sign is something which stands to someone for something else in some respect or capacity” (Liu 2000, 13). People are using signs routinely to communicate with each other. In Oxford Dictionary the definition of semiotics is:

“The study of signs and symbols and their use or interpretation”.

Figure 7 illustrates Stamper’s (1992, IX.2) semiological ladder. Traditional semiotics divisions are syntactics, semantics and pragmatics. According to Stamper (1992, IX.2), there should be added also physical, empirical and social divisions. The physics of signs concern the media and the hardware, the empirics of signs treats the statistical properties of sets of signs and in social dimension all other divisions find their purposes. Another name to a semiotic framework is an information theory.

The empirics and syntactics divisions are most closely with Shannon’s work. Three upper divisions and the physical world are those ones, which Shannon excluded from his information theory. Nonaka (1994, 16) states that the syntactic aspect of information is illustrated by Shannon’s analysis of the volume of information which is measured without regard to its meaning or value and furthermore, the syntactic aspect does not capture the importance of information in the knowledge creation process. Anyway Shannon’s information theory is groundbreaking and many times he has been heard to be called the father of the Digital Age and his theory “a blueprint for the digital age” (Aftab et al. 2001, 3).

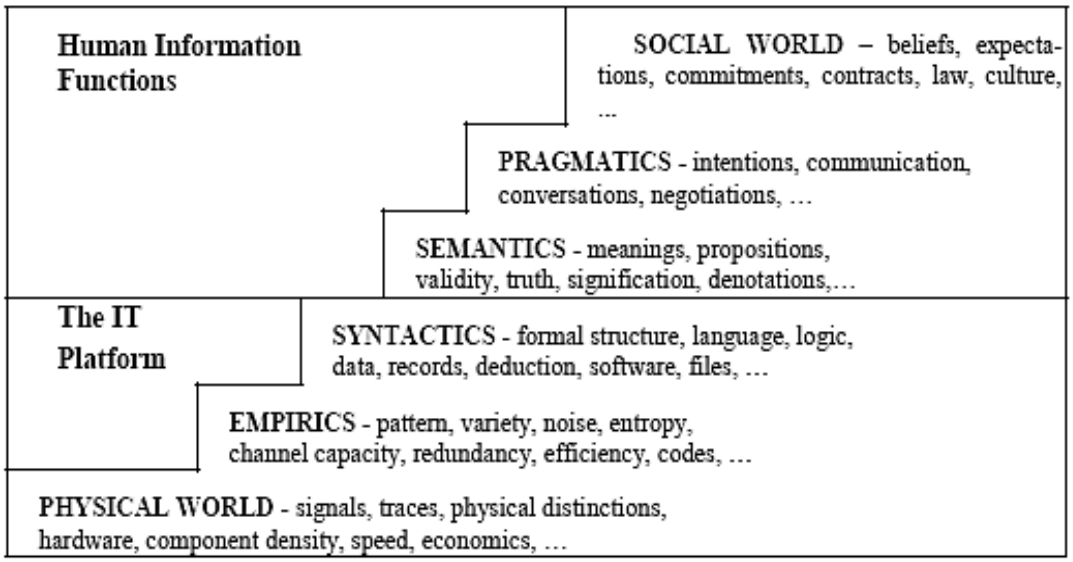

FIGURE 7. Semiological Ladder between the Physical and the Social World (Stamper 1992, IX.2)

The divisions of semiotics traditionally have been syntactics, semantics and pragmatics, which deal with the structures, meanings and usage of signs, reflecting the philosophical roots of the subject. The factors, which cover the economics of signs, have become important lately. That is why the physics of sign must be added.

The Human Information Systems level, on which this research focused, includes semantics, pragmatics and social world. *Semantics* is concerned with meaning, to which can be given a variety of meanings in the physical, empiric and syntactic domain. *Pragmatics*, a sign must always have an intention, which have given by its creator or its interpreter, without that it does not have any use. The key word at the *pragmatics* level is possibly “communication” where it is fully explained. At the social level “information” is perhaps best understood as a process of imparting to a social situation. (Stamper 1992, 6-10.)

Stamper (1992, IX.11) emphasizes that the organization is the real information system. There is no information until there is a society able to confer the sign-property, so information is impossible without society and its shared culture. All information systems are social systems. Davenport’s (1997, 13) view supports this, when he is saying that information and knowledge are essential human creations, and we will never be good at

managing them unless we give people a primary role. Stamper (1992, XI.12) states also that IT systems only have a value to a business in so far as they embody the solutions to problems belonging to the social domain. According to Davenport (1997, 3), our fascination with technology has made us to forget the main purpose of information: to inform people.

2.4 The Quality and the Value of Information

When computers became little by little common at the end of the 1950's there emerged a growing awareness of the need to measure data quality. Maffei (1958, 186) stated that a theory of the cost and value of information was needed. Trueblood (1960, 48) focused on better information saying that the purpose is not to replace management judgment, but to provide more and better information. Different information attributes were defined, when information quality was conceptualized. Ballou and Pazer (1985, 152) expanded the scope of information quality beyond accuracy, which was almost the only attribute of information quality until then. Ballou and Pazer argued that the other attributes including information quality are timeliness, consistency, completeness, relevance, and reliability. According to Klein (2001, 9-18), data and information quality are commonly thought of as a multi-dimensional concept with varying attributed characteristics depending on an author's philosophical view-point.

To get the right information there has to be the right data. Redman (1995) introduced a simple three-step strategy for, how to improve data quality. First, the problem has to be identified. Secondly, information has to be treated as an asset, which means that the roles of data suppliers and customers should be identified, responsibilities should be arranged accordingly and the organization should commit to investigating "resources to improve the quality of the asset". The third step is the embrace of advanced quality management approaches for proactively addressing data problems. Redman suggested that companies should first focus on preventing the introduction of errors, with a clean-up if necessary. He said that "a database is like a lake. To ensure a clean lake, one must first eliminate the sources of pollution". (103-106.)

According to Klein (2001), data and information quality is commonly thought of as a multi-dimensional concept with varying attributed characteristics depending on an author's philosophical view-point. (9-18.)

Stair and Reynolds (2012) argue that value is generally regarded as importance, worthiness or usefulness. The value of information is directly linked to how it helps decision makers achieve the organization's goals. To be valuable, information must have several characteristics. It should be accurate, complete, flexible, economical to produce, relevant, simple to understand, verifiable, timely, accessible, and secure. (36.) Organizational information has to have at least some of these characteristics, because characteristics make the information more valuable to organizations. Good information is information, which is used and which creates value. It is the base for an organization's decision-making. Information needs to be accurate enough depending on the need. The degree of the accuracy of information depends on the circumstances. Sometimes accuracy has to be very high like in statistics, which is used for instance in decision-making in big investments. In some cases it is not so important to have information that is close to 100%, because it would be too expensive to produce.

Good information is often incomplete, which means that it does not contain all the details required by the user. To get all the relevant pieces of information, it has to be collected from a variety of sources. Complete information contains all the important facts.

Information should always be economical to produce. This is the situation, in which decision makers have to balance. Flexible information can many times be economical, since it can be used for a variety of purposes. Relevant information is important to users. Irrelevant and complex information just overloads users and delays decision-making. If decision makers receive too much information, it is difficult to determine what is really important, so users should trust information they receive. Many times the reliability of information depends on the right data and the reliability of data-collection methods. It is also very important that information is delivered, when it is needed and information is verifiable meaning that it can be checked to make sure its correctness.

2.5 Information Flow and Information Systems

An organization is a stable, formal social structure, which takes resources from environment and processes them to produce outputs. Organizations are formal legal entities and also social structures. The connections between organization and its departments comprise information flow. Stair and Reynolds (2012, 17) emphasize that information systems personnel are the most important element in most computer-based information systems and they are those, who make the difference between success and failure for organizations. Users are those, who work with information systems to get results.

Radding and Tuck (1991) recognized some important questions regarding information flow within a company: Where does the information come from? Where the information should be sent? Who is in charge in filing? Who provides the information? Who needs the information? (p. 26-31.)

The information flow is the lifeblood of the organization and it cannot exist in absence of this flow (Rodgers & Rodgers 1976, 49-50). There are many different theories about the information flow. Many of these theories are relevant to the business environment like Huhtinen and Ojala (2001, 6) define that the transfer of information between two or more persons or larger entities, such as departments of a firm or within a firm, is communication. The flow or exchange of information is often used to model communication (Jonker, Treur and Wijngaards 2000, 1).

Reeker and Jones (2002) argue that information is transmitted in two different components. Firstly, there is a physical component, a so-called potential information, which is capable of transmitting information, but without attaching any meaning. The second component is mediate information, through which the potential information becomes meaningful. The physical information, which is sent out, is not meaningful until it is interpreted and it reaches its recipient. Before that it is just data, or potential information. Figure 8 illustrates the relationship between the potential information and the meaningful information, which is also called semantic content or knowledge. (p. 6-11.)

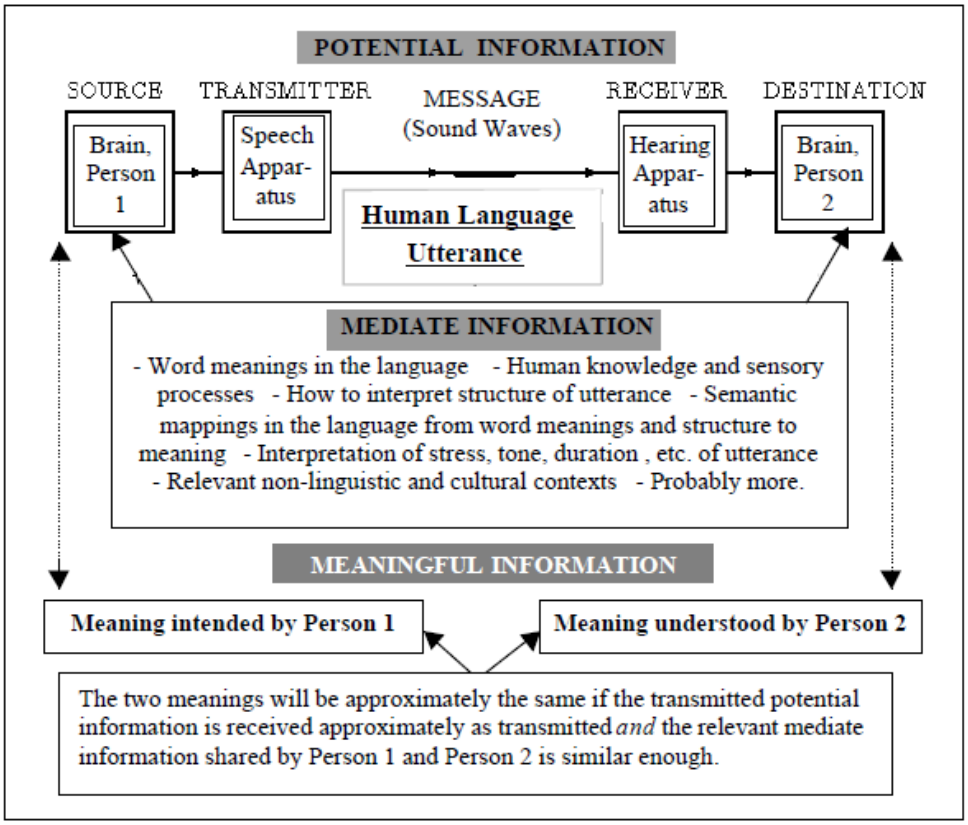

FIGURE 8. Potential and Mediate Information (Reeker & Jones 2002, 11)

It is obvious that information and its efficient flow in organizations are the most important factors. In organizations for instance supply chains' efficiency depends on the information flow. Organizations operate nowadays in the business environment, which is changing and becoming more and more complex. Information has to be on-time and it has to be received by the right people in organizations. Davenport (1997, 30) pointed out that information ecologies constantly change, which means the information systems in place also need to be flexible.

One of Metsä Board's strategy elements is the top-class supply chain. The ongoing supply chain management project is aiming at establishing a world-class supply chain, which should be ready in 2014. The targets of the project are to improve customer service, shorten delivery times further and decrease capital employed. (Metsä Board Annual Report 2013, 5.) All these targets demand an effective information flow during and after the project.

According to Stair and Reynolds (2012, 3), an information system (IS) can either hamper people from the proper business practices or it can help them establish the best practices across an organization. “The best practices” refers to the business practices, which provide a competitive advantage. According to Porter (1985, 2), it is important that managers in organizations understand that an information technology is more than just computers. Davenport (1997, 10) accentuates that computers are well-suited for helping us manage data, less so for information, and even less for knowledge.

Stair and Reynolds (2012, 10) state that IS are a set of interrelated elements of components. Figure 9 illustrates IS components that collect (input), manipulate (process), store, and disseminate (output) data and information and provide a corrective reaction (feedback mechanism) to meet an objective. The feedback mechanism is the component that helps organizations achieves their goals.

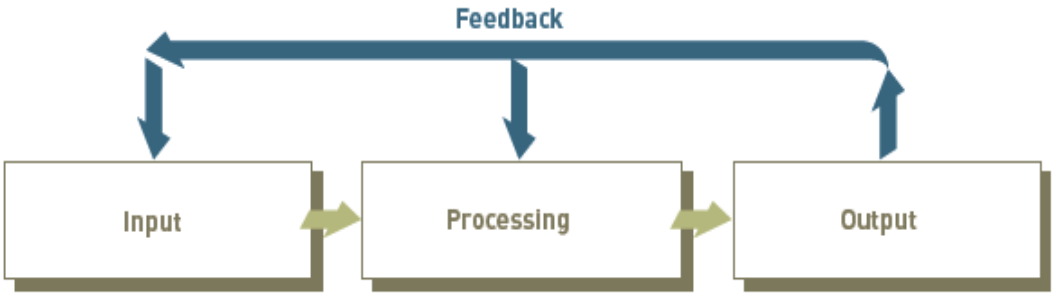

FIGURE 9. The Components of an Information System (Stair and Reynolds 2012, 11**)**

Organizations and information systems influence one another and the interaction between them is complex. Many mediating factors like organization’s structure, politics, business processes, culture, surrounding environment, and management decisions are influenced the interaction between information technology and organizations.

2.6 Information Management and Knowledge Management

The idea of capturing knowledge gained by individuals and spreading it to others in organizations is called knowledge. For a long time European countries were primarily

concerned with measuring knowledge, American companies focused on managing knowledge effectively by using IT and Japanese companies focused on creating new knowledge organizationally. Lately these various approaches to knowledge management are coming together. (Takeuchi 2001, 315.)

Japanese companies have been very successful even if they have not been terribly efficient, entrepreneurial or liberated and this has remained an enigma to most Westerners. Nonaka and Takeuchi (1995, 3) argue that this is because Japanese have skills and expertise at "organizational knowledge creation". By organizational knowledge, they mean the capability of a whole to create new knowledge, disseminate it throughout the organization, and embody it in products, service, and systems. Oneness of humanity and nature, oneness of body and mind, oneness of self and other, form the foundation of the Japanese view toward knowledge and also the Japanese approach towards management practice. (Nonaka and Takeuchi, 1995, 27.)

It is always difficult to see the difference between an information management and a knowledge management. Davenport and Prusak (2000, viii) noted that the knowledge management initiatives almost always include some mix of information and knowledge, and it is not always easy to disentangle them from each other. Also Huvila (2006, 12) maintains that the interface between the information management and the knowledge management is quite indecisive. The information management is commonly defined as the structuring and processing, if information in organizations with the goal of improving the premises of organizational performance. It is also a practical perspective, which focuses on and analyzing existing information sources, methods, strategies and processes.

The information management is extremely important nowadays, since failure to effectively manage information, can damage productivity and potentially damage customer relation and business reputation. Moreover, businesses can also miss potential opportunities to access new markets and improve performances. Used effectively, information has the power to drive improved business performance and improve economic effectiveness throughout the economy. (Deloitte 2011, i-3.)

Davenport and Prusak (2000, xv) noted that knowledge is one of the most important resources of any organization. So the knowledge management should become a part of everything in organization and be a part of everyone's job.

2.7 The Most Critical Components of Information Ecology

In any information ecology there are three environments. Information ecology emphasizes an organization's entire information environment. Rather than focus on technology, information ecology focuses on, how people create, distribute, understand, and use information at its center – it is a holistic approach to information (Davenport 1997, 4-5, 28).

Davenport's (1997) information ecology describes the information and knowledge environment and explains why technology is not enough for success. He focuses on the information environment of a company. The information environment is the core of an ecological management approach in his ecological model and it encompasses the six most critical components of information ecology – strategy, staff, culture/behavior, politics, architecture and processes. (p. 34.) The information environment, which is the core of Davenport's ecological management approach, is used as a prime theoretical framework in this thesis. Hence, a holistic approach to the exchange of environmental information is the main focus of this study.

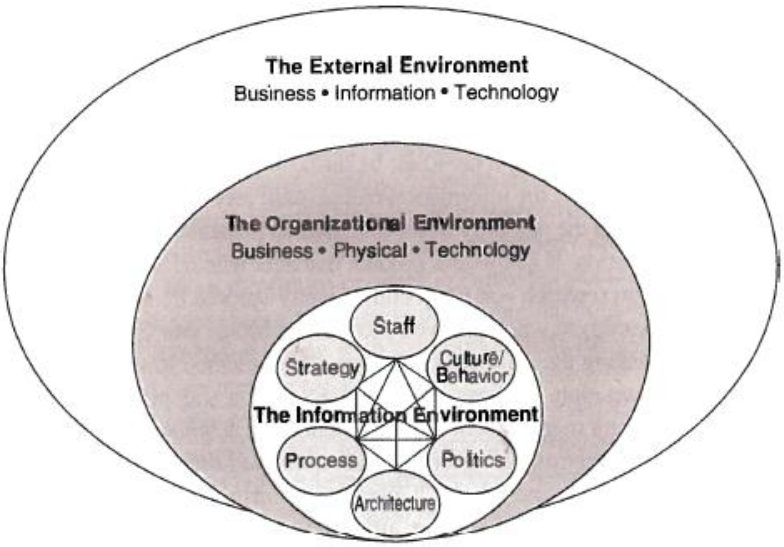

FIGURE 10. An Ecological Model for Information Management (Davenport 1997, 34)

Figure 10 shows three environments, which are the external environment, the organizational environment and the information environment. The inner circle of Davenport's model is the information environment and it represents the core of an ecological approach to management. The circle includes the most critical components of information ecology.

Davenport (1997, 47) argues that *information strategy* can potentially include all the aspects of informational ecology. A good strategy promotes communication, debate and consensus and it also means making choices. Mintzberg's (1994, 107) views can be considered as consistent with Davenport's when he states that the most successful strategies are visions, not plans. Many companies need an information strategy, because information environments in most firms are a disaster, information resources can be better allocated, information strategies help organizations adapt to change and make information more meaningful. And after all, it is not so burdensome to do it. (Davenport 1997, 47.)

A missing information strategy, people's behavior, sophisticated IT like an internet and e-mail can be some of the reasons for an information overload. Information overload is a big problem in many organizations nowadays. According to the MacMillan Dictionary an information overload is "a situation in which you get more information than you can deal with at one time and become tired and confused". Some people want to hoard information and they are unwilling to share it with others. In some cases information is just piling up and nobody is sharing it or demolishing unnecessary information. New sources and media of information are coming, but the old ones do not go away.

Travica (2005, 212) defines *information politics* in terms of power, agendas, and fights/flights that concern organizational information and IT. Davenport (1994, 67) continues by saying that information is affected constantly in virtually all organizations by power, politics, and economy. But information politics remains often "undiscussable", perhaps because it would somehow undercut an organization's existing hierarchy.

Wilson (2000, 49) explains that the definition of *information behavior* is the totality of human behavior in relation to the sources and channels of information, including both active and passive information seeking, and information use. According to Davenport (1997) information behavior refers to how individuals approach and handle information. This process includes searching, using, modifying, sharing, hoarding, and even ignoring it. In his opinion, it is very important that organizations manage information behavior, since better management of information behavior can also lead to control of information costs. Furthermore, managing information behavior is not only a sign of internal effectiveness, but also a possibility to achieve competitive advantages. (p. 83-86.)

Making information meaningful is the primary goal of *information staff.* Information must have value in order to be meaningful. Information has value for decision makers, if it has certain characteristics that define its value. Davenport (1997, 116-117) proposes six characteristics that determine the value of information in organizations: accuracy, timeliness, accessibility, engagement, applicability, and rarity. All these characteristics can affect everything from strategy to politics.

Davenport (1997, 134) describes a generic *information management process* with four steps: determining information requirements, capturing, distributing and using information. According to Davenport, when an executive takes charge of information management, it sends a signal to the organization that this is an important area to get right.

Detlor (2010, 103-108) points out that there exist various perspectives of information management like the organizational, library and personal perspectives. Davenport has focused more on organizational perspectives.

Davenport (1997, 156) states that *information architecture* (IA) is simply a set of aids that match information needs with information resources. The definition of Toub (2000, 2) emphasizes that IA is the art and science of structuring and organizing information environments to help people effectively fulfill their information needs.

In recent years there have been big advances in displaying massive amounts of data to make them easily accessible. This notion is supported by data-visualization specialist Martin Wattenberg, who thinks that visualization deals with the inhuman scale of the information and the need to present it at the very human scale of what the eye can see (The Economist 2010).

FIGURE 11. Map of the Market (Wattenberg 1998)

Figure 11 illustrates Wattenberg's Map of the Market, which he designed while he was working at Smart Market.com. The Map of the Market was one of the first visualizations on the web. Map of the Market is displayed live stock market data. Its goal was since 1998 to give a quick answer to the question, "what is happening in the market?" (Wattenberg 1998).

The fact is that IA is quite a new field and its history goes back no further than the mid-1970s. It was developed to handle soundly large quantities of information that flows in the internal and external environment of an organization.

IA is defined by Information Architecture Institute (2007) as:

1. The structural design of shared information environments.
2. The art and science of organizing and labelling web sites, intranet, online communities and software to support usability and findability.

3. An emerging community of practice focused on bringing the principles of design and architecture to the digital landscape.

Resmini and Rosati (2011, 33) define IA as a professional practice and field of studies focused on solving the basic problems of accessing, and using, the vast amounts of information available today.

The current information sources such as the internet and e-mail are producing a huge amount of information, which demand capability to handle it. According to McCandless (2012, 6-7), in a way we all are visual now, since we are seeing and absorbing information via web all the time.

As mentioned earlier Davenport's information environment of a company includes six components. These components will be reviewed closer in the following paragraphs.

Information Strategy

According to Davenport (1997, 46-47), strategy is a continual, incremental process of setting and resetting organizational direction. It should not be detailed, since we cannot anticipate the future in detailed. Strategy is a dialogue rather than a document. Also strategy and planning should be done by business managers and not 'strategic planners'. Many organizations do not have information strategies, but there are good reasons to think strategically about information like the following ones:

- Information environments are a disaster in most companies
- Information resources can be better allocated
- Information strategies help organizations adapt to change
- Information strategies make information more meaningful
- Information strategy is not that burdensome

Information Staff

Davenport (1997, 108-120) states that the support structure of any information environment has to focus on the people who add value to the information. Moreover, he continues saying that the primary staff goal is to make information meaningful. The

meaningful information has value and certain characteristic can define the value of information in organization. Davenport (1997) suggests the following six characteristics:

1. Accuracy – information must be accurate to be perceived as valuable and to be used with confidence.
2. Timeliness – information must be up to date to be any use at all.
3. Accessibility – information may not be worth the effort to use, if it is too difficult or time-consuming to obtain.
4. Engagement – information, no matter how valuable it is otherwise, must be noticed to be useful.
5. Applicability – information is applicable, when it can be directly used to solve a business problem or support a business decision without extensive rearranging or further analysis.
6. Rarity – information with rarity often conveys power and information environments are inherently political. Rarity may make all the difference to a given piece of information value.

Information Culture/Behavior

Information behavior refers to, how individuals approach and handle information. A better management of information can also lead to control of information costs. Three critical types of information behavior, which improve a company's information environment, are the following ones:

- sharing – the voluntary act of making information available to others.
- handling overload – information must be communicated in a compelling way that encourages the right people to recognize and use it.
- dealing with multiple meanings – sometimes the multiple meanings of information must be managed and controlled. It must also be prepared to maintain common information by monitoring and policing its use across the organization. (Davenport 1997, 83-97.)

Information Politics

Davenport (1997, 67-68) accentuates that information is affected constantly almost in all organizations by power, politics, and economics. It is very important that company's

management talks honestly and directly about the political nature of information. Addressing information politics explicitly is what matters for information ecology.

Information Architecture

According to Davenport (1997), in spite of the potential of information architecture, it has a motley past in real organizations. Most of the architectures have only dealt with computer-based information for decades. Many information architectures have never completed or taken too long to implement. Architecture will get nowhere without a consideration of human behavior and motivation. An ecological approach to an information architecture demands the good measures of desired behavior and that is the only way to tell, if a given architectural blueprint really reflects, how people use information, or how they successfully maps a new way to do something. (158-161.)

Information Management Processes

Davenport (1997, 134-151) accentuates that a generic information management process includes four steps: determining information requirements, capturing, distributing and using information. The figure 12 shows, how the process actually works according to Davenport.

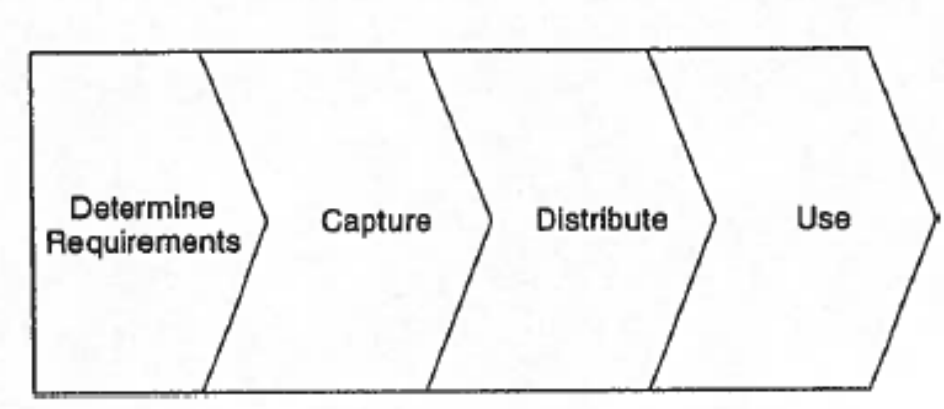

FIGURE 12. The Information Management Process (Davenport 1997, 135)

Determining information requirements involves identifying, how staff in organization makes sense of their information. Capturing information is an ongoing activity in organization including several other activities like scanning, categorizing, and formatting information. In distributing information, it is very important that it is in the right form, it

goes to the right people, at the right time. The final step of an information management process is the use of information. Information is no good until and unless it is used.

The most critical components of information environment described above give a base, against which it is possible to reflect Metsä Boards environmental information exchange. These components enable more extensive study of the company's information exchange and the components enable examination from different viewpoints.

3 METHODOLOGY

Information encompasses many different scopes clearly indicated by the literature reviewed. Davenport's (1997) information ecology model gives a good foundation and guidelines for the research, when studying information and information exchange in practice. Based on this Davenport's six components of information ecology is used as framework in this study.

3.1 The Research Approach and Action Research

A qualitative research was chosen as a research approach in this research. Denzin and Lincoln (1994) state that qualitative research often studies phenomena in the environments in which they naturally occur and research uses social actors' meanings to understand the phenomena. (2.) Qualitative research provides insights that are difficult to produce with quantitative research. This research approach helps to understand, what environmental information is and what all it includes. Qualitative research can, and should, be conducted in a manner that stands up to external scrutiny, and outlines our view that qualitative studies can be used to draw wider interfaces about the nature of the social world (Ritchie et al. 2014, xxiii).

Action research was used in this study as method. According to Reason and Bradbury (2001) a primary purpose of action research is to produce practical knowledge that is

useful to people in their daily lives. Action research is about working towards practical outcomes, and also about creating new forms of understanding, since action without understanding is blind, just as a theory without action is meaningless. Action research aims to be a systematic process. (1-4.)

The main aim of this research was, first to get a good understanding of the environmental information exchange process at Metsä Board's Finnish board mills. Another aim was to investigate proposals for improvements and based on these proposals start to implement them. Action research was selected as method, since it was expected to give the needed practical outcomes and a new understanding of environmental information exchange in the company.

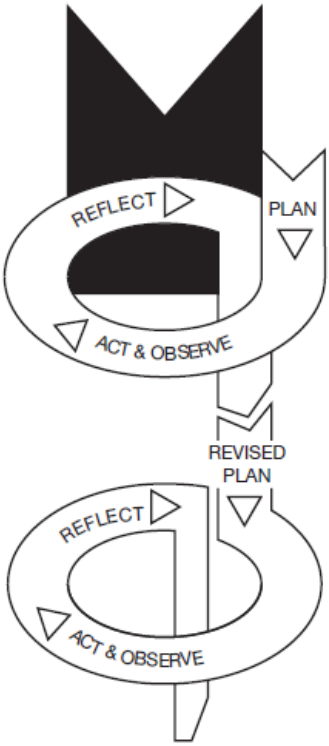

FIGURE 13. The Action Research Spiral (Kemmis and McTaggart 2008, 278)

Figure 13 illustrates the spiral model of action research proposed by Kemmis and McTaggart. This is one of the action research models, but the main idea is the same in all of them. They all are disciplined and systematic processes.

According to Harrison and Callan (2013, 1), researchers who are interested in qualitative methods, action research allows them to use research that consists of first-hand experiences, people's stories guiding the aims of good research to solve real-world problems while dealing with localized contingencies. Action research was considered in this study as methodology not a method. Referring to McNiff and Whitehead (2011) a methodology is the overall approach to a research programme, including the research topic, question, conceptual framework, intents and purposes, value-orientation, data collection, interpretation and analysis, validation, procedures, and so on, whereas a method is a specific technique to gather data. (48-49.) Dawson (2009, 17) agrees with McNiff when saying that action research is better understood as a methodology. In action research the researcher works in close collaboration with a group of people to improve situation in a particular setting.

Qualitative data collection methods like interviews, observation and documents were used in this study. By using action research as a method, made it possible to contribute to new practices in environmental information exchange and to contribute to new ideas and knowledge. As a participant in the meetings, which dealt with environmental and water efficiency issues, the author had a good opportunity to use action research including action and research parts. In the meetings it was possible to get a better understanding about the current environmental information exchange and also to suggest changes and improvements. Reason and Bradbury (2013) state, the primary purpose of action research is to produce practical knowledge useful to people in their daily lives. Therefore, it is about working toward practical outcomes, and also about creating new forms of understanding, since action without reflection and understanding is blind, just as a theory without action is meaningless. (1-4.)

According to McNiff and Whitehead (2011), action in action research action means taking action to improve a practice and research means finding things out and coming to a new understanding, that is, creating new knowledge. In action research the knowledge is about how and why an improvement has happened. Moreover, action research is the form of enquiry that enables practitioners in every job to investigate and evaluate their work. The *action* part of action research is about improving a practice.

The *research* part of action research is about offering descriptions and explanations for what you are doing as you improve a practice. (7-14.)

McNiff's and Whitehead's notion is supported by Coghlan and Brannick (2010, 5), stating that the desired outcomes of the action research are a contribution to scientific knowledge and theory. Action research is both a sequence of events and an approach to problem solving. Furthermore, action research attempts to meet the dual goals of making action more effective and building a body of scientific knowledge around the action (Cheung-Judge and Holbeche 2011, 32). Harrison and Callan (2013, 1-3), accentuate that action research can be used to replicate or add to an experience that works well and not just to improve unsatisfactory situations. In action research the researcher ought to be useful as well as observer, whereas case study research examines phenomena in their 'natural' environment with the researcher as on independent (separate) observer. All these statements confirm that action research was the best option in this case.

3.2 The Research Plan and Strategy

Strategy signifies, what is wanted to do. In this study the research strategy was to find answers to the following research questions:

- What actions need to be taken to improve the environmental information exchange at Metsä Board?

- How can these actions be implemented?

Figure 14 illustrates the research plan, which also describes, how the research strategy was executed. First, the plan was to get to know the relevant literature. Secondly, the decision was made to use action research as a methodology and not just a method. Then different data collection methods were selected to get reliable findings. According to Kemmis and McTaggart (2009), the process of action research itself is generally thought to involve a spiral of self-reflective sequence of cycles of the following:

planning, acting and observing, reflecting, re-planning, acting and observing again, reflecting again and so on. Action research is a social process, participatory, practical and collaborative, emancipatory, critical, reflexive and it aims to transform both theory and practice. (271-283.)

The research findings helped to clarify information exchange process. The findings clarified the elements, which made information exchange more effective, and which elements were needed to distribute information to a wider audience in the company.

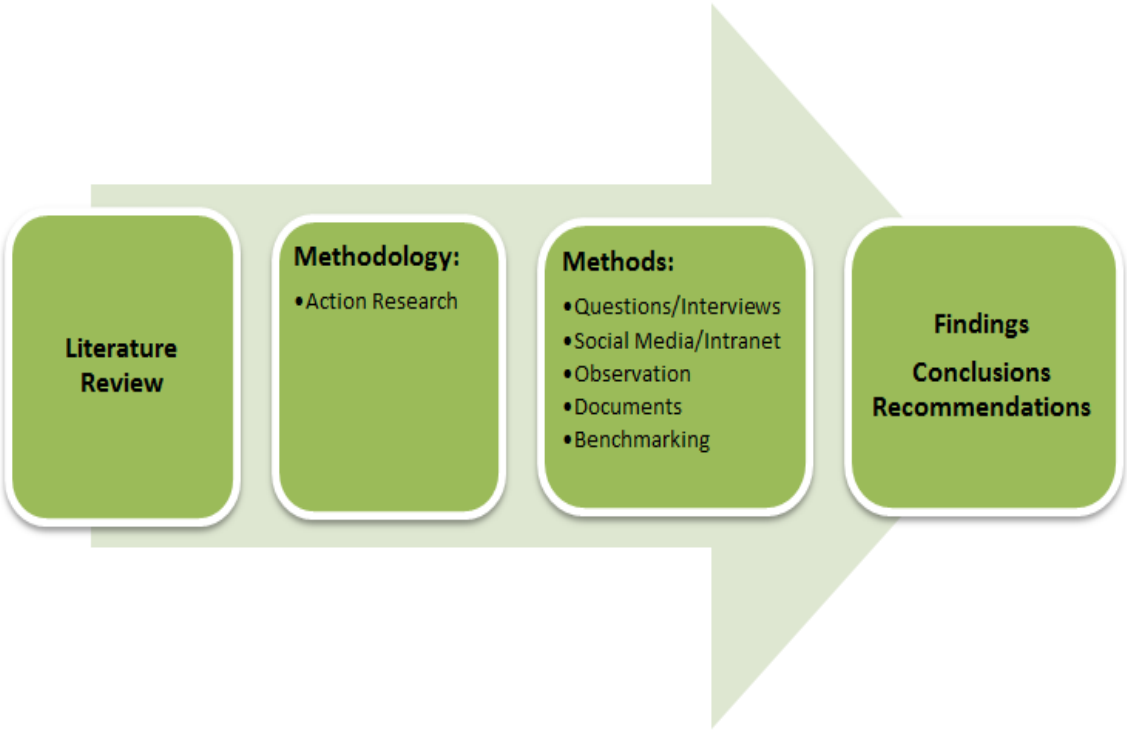

FIGURE 14. The Research Plan

3.3 Data Collection

The purpose of gathering data is to generate evidence (McNiff 2011, 147). According to DiCicco and Crabtree (2006, 314), the purpose of the qualitative research interview is to contribute to a body of knowledge that is conceptual and theoretical and is based on the meaning that life experiences hold for the interviewees.

3.3.1 Questions and Interviews

This research started by interviewing Metsä Board's environmental managers to get to know better the current information exchange process. This enabled to get to know the topic and get to know generally, how the environmental information exchange worked, and who were involved in process. After that open-ended questions were sent to the environment managers to fill in during the coming weeks. When all answers were received and studied, environmental managers' interviews were organized. Individual interviews were done via Lync-system, based on the open-ended questions. The individual interviews were arranged, since they produced more accurate and reliable information, and this way it was possible to create interaction and reflection with the interviewees.

The group of interviewees consisted of five environmental managers. Firstly, one of the environmental managers was interviewed to get more a detailed picture of the current environmental information exchange at Metsä Board as already mentioned earlier. The first interview took place on Friday, 30 August 2013 at noon, at mill, in manager's office. Manager introduced her daily work including IT systems, which she used in the internal and external environmental reporting. The interview included some common, semi-structured questions, which were made in advance. The whole interview took one and a half hours. The interview was recorded with manager's permission. Recording was done to make sure that all information was caught and nothing was forgotten later.

All questions and interviews were in Finnish, since all participants were Finnish speaking people. This eliminated possible misunderstandings. The questions were translated into English and can be found in the appendices.

According to Bernard and Ryan (2010) in semi-structured interviews, each informant is asked a set of similar questions, whereas in structured interviews each informant is asked a set of identical questions. Bernard and Ryan also state that semi-structures interviews are flexible meaning that the interviewer can modify the order and details of how topics are covered. (29.) Hence, semi-structured interviews were selected in this study for one of the qualitative research methods, since the method gave certain

advantages. It made it possible to get personal contact with the interviewee. It provided rich information and insights and also offered a broader picture of the research area.

Kvale and Brinkmann (2009, 2) accentuate that the research interview is based on the conversations of daily life and it is a professional conversation: it is an inter-view, where knowledge is constructed in the inter-action between the interviewer and the interviewee. According to Dawson(2009, 28), interviews should remain flexible so that other information can still arise. Hence, the interviews in this study were remained as flexible as possible, which advanced to receive more information.

After the first interviews, the open-ended questions were created and sent on Thursday, 12 December 2013 to all environmental managers. Managers had possibility to go through questions and also answer them in advance. Gillham (2008, 5) argues that open questions are more difficult to analyze than closed questions, but open questions can lead to a greater level of discovery. That is one reason, why open questions were chosen here. This is why it was possible to get a good and clear overview of the environmental managers' roles, responsibilities and challenges.

It was agreed with all the managers that interviews based on the open-ended questions would be arranged between January 2014 and February 2014. So the one-hour-long interviews took place via Lync as follows:

- On Friday, 3 January 2014 at 10:00 am
- On Friday, 10 January 2014 at 10:00 am
- On Monday 13 January 2014 at 10:00 am
- On Thursday 23 January 2014 at 02:00 pm
- On Tuesday 4 February 2014 at 10:00 am

After the questions and first interviews were done and analyzed, it became clear that more information was needed. Thus, a new set of open-ended questions were sent to environmental managers on Wednesday 9 April, 2014. The questions were sent by e-mail to four managers, who worked at the integrated mills. The open-ended questions were not identical, since certain things functioned well at certain mills, but did not work

at other mills. The purpose was to get some ideas, how environmental information worked at Metsä Fibre mills and after that to compare the received answers with the answers from Metsä Board mills. So benchmarking was used in the study as a method to compare Metsä Fibre's and Metsä Board's practices and find the best ones. It was noticed after the first questions that a small-scale benchmarking could give more valuable information to the research, since benchmarking identifies differences in organizational practices. That was the reason, why this time the questions were sent only to the environmental managers at the integrated mills.

All the managers answered the questions and the answers were analyzed immediately after they were received. After that the timetable of Lync interviews was agreed. The purpose for these interviews was to have flexible interviews, which possibly included more useful information and offered a broad picture of the research area. The aim was also to add study's reliability by using open-ended questions and interviews together. This procedure also eliminated possibilities of misunderstandings. The second interviews took place by phone, as follows:

- On Monday, 7 April 2014 at 01:00 pm
- On Monday, 7 April 2014 at 02:30 pm
- On Monday, 14 April 2014 at 09:30 am.

All these interviews took about 20 minutes.

A direct observation was used as a data collection method together with questions and interviews. When you want to know what people do, rather than what they say they do, nothing beats watching them (Bernard et al. 1984, 495-517). Observation took place in the meetings as follows:

- On Tuesday , 7 May 2013
- On Tuesday, 4 June 2013
- On Thursday, 5 September 2013
- On Thursday, 21 November 2013
- On Wednesday 12, February 2014.

Data was also collected from documents as annual reports, meeting minutes from meetings as mentioned above and from Metsä Group's intranet web pages.

Since all participants were Finnish speaking people, the interviews were in Finnish. This ensured that there were no possibilities for lingual misunderstanding. Also the amount and diversity of the received information was quite big. In addition, all managers sent their answers to open-ended questions before interviews, in writing via e-mail. Hence, the process like this produced accurate information, and verified research's reliability.

3.3.2 Observation and Documentary Analysis

The observation was done in the meetings. Since the purpose of observation was known, it was possible to focus on it. The traditional paper/pencil method was used. Observation reports were used to record observations. The observations were used to gain insights into information exchange structure, to discover needed changes and improvements. The observation situations were normally quite short like observations of the meetings and conversations, but as Neuman (2004, 268) states, this method enables to grasp multiple perspectives in a natural social settings.

Written documents as annual reports, meeting minutes, memos, articles and other company's published material were used together with other methods to gain deeper understanding of the subject. Also different web pages of Metsä Group and Metsä Board were utilized.

Documentary analysis supported and confirmed the findings from the interviews. The used written material can be considered reliable and up-to-date, since Metsä Group's and Metsä Board's web pages are addressed to public use. These pages were given diversified, valuable and useful information to this research.

FIGURE 15. Metsä Board's Strategy (Metsä Board Annual Report 2013, 4)

According to Metsä Group's strategy, it focuses its operations, investments, and resources on areas where it has a clear competitive advantage and that offer good growth prospects (Metsä Group Annual Review 2013, 4). Figure 15 clarifies the elements of Metsä Board's strategy. The core business is paperboard business. The company's plan is to have smaller paper business in the future than it is now. Also extensive fibre know-how, pulp self-sufficiency, continuous development towards super productivity and top-class supply chain are Metsä Board's main elements in its strategy (Metsä Board Annual Report 2013, 4).

Metsä Board accentuates that sustainability is the basis for its success. One of the sustainability themes is environmental and resource efficiency. Its fields include energy and climate, water efficiency, material efficiency and material risk management. The company has already decreased fossil CO2 emissions in production by 35 per cent during 2009-2013 and the aim is still to reduce it. Metsä Board's target is to reduce process water consumption by 10 per cent by 2020 from the 2010 level. Improvement projects of the water consumption and material efficiency started in 2013 and it will continue in 2014. (Metsä Board Annual Report 2013, 12-13.)

Since board mills use ready-made raw materials as pulp in their production process, there is no need to produce it themselves. This means that environmental load arising from process is not as big as it is in pulp production. In pulp production amount and nature of the used chemicals are different than at board mills. Chemicals, which are used in pulp process, are very harmful if those chemicals by accident get into the environment. The impacts of accidents can be very far-reaching. From this point of view, it can be thought that environmental issues have more important significance at pulp mills than it is at board mills. Maybe that is the reason, why Metsä Fibre's focus on

environmental issues is more organized and information goes already now all the way to the management level.

Board mills emphasize effluent treatment in its environmental planning. Even if Metsä Board and Metsä Fibre emphasize different environmental areas, both of them take environmental issues seriously. Demands of the environmental authorities are becoming stricter than before. The recent environmental accidents and crimes have speeded up creation of new environmental regulations and laws. Also European Union's directives set new challenges to all industries. It would be very important to take in consideration these new trends and provide for these. More active and organized environmental information exchange at Metsä Board's mills would be important.

The investigated written documents gave a clear picture about Metsä Board's environmental focus. Metsä Board is a part of Metsä Group and the focus is on sustainability. As mentioned earlier sustainability is the basis for Metsä Board's success. Metsä Group accentuates that they ensure that their operations are sustainable and all their products are safe for both people and the environment - sustainable throughout the value chain. Metsä Group publishes also a separate Sustainable Report each year.

The observation was done during the whole study and especially in the meetings, where main topics were water and effluent treatment issues. The observations were made about conversations and people in the meetings and notes were written down immediately. Many environmental issues came up in the meetings like the need to improve environmental information exchange between board mills at all levels, environmental information should go from the operational level to the top level and Metsä Board's environmental management practice needs clarification and development.

3.4 Data Analysis

Qualitative research approach was used in this study as mentioned in Chapter 3.1. This made it possible to understand the process of environmental information exchange. It

also meant that data collection and data analysis took place at the same time. In this study a highly qualitative and reflective type of analysis was conducted. Dawson (2009) states that for qualitative data the researcher might analyze the research progresses, continually refining and reorganizing them in light of the emerging results. At the one end there are highly qualitative, reflective types of analysis, whereas on the other, there are those that process the qualitative data in a quantitative way, by counting and coding it. (115-116.)

Since the data in this study was at a manageable level, the analyses were completed during the research with no special software used in analyzing it. Instead an open coding, a line-by-line analyzing process was used. The process was quite time-consuming, but it gave the needed detailed information. First a 'big picture' of the data collected had to be found. This took place by reading and rereading the data a few times and when the data was familiar, it was time to focus on certain aspects of it, which seemed more important than others. After that the focus was on certain things repeated in the answers. The answers were coded by focusing on rallying points. Charmaz (1983) argues that codes serve to summarize, synthesize, and sort many observations made of data. Coding becomes the fundamental means of developing the analysis. (112).

According to Dawson (2009, 119) for those at the highly qualitative end of the continuum, a data analysis tends to be an on-going process, taking place throughout the data collection. Furthermore, Bleach (2014, 25) refers to Strauss and Corbin(1998), when saying that throughout the process, the data has to be critically analyzed including a reflection on what has been learnt and what need to be done next.

In this study, the emerging themes were thinking and reflecting on and the methods were also adapted and changed if required. Also, interview summary forms were created and completed as soon as possible after the interviews. After the first interviews, the analysis showed that the second interviews were necessary for getting more useful information and proposals for improvement from the experts.

3.5 Reliability and Validity

Reliability and validity as quality indicators have an uneasy standing in qualitative research and are subject to numerous debates. Golafshani (2003, 597) states that qualitative research uses a naturalistic approach that seeks to understand the phenomena in context-specific settings. According to Patton (2002), it is a real world setting, where the researcher does not attempt to manipulate the phenomenon of interest. While the credibility in quantitative research depends on instrument construction, it means that the researcher is the instrument in qualitative research. (39, 14.)

There are still arguments, if reliability can be used as a criterion in qualitative research. Stenbacka (2001, 552) accentuates that the concept of reliability is even misleading in qualitative research. If a qualitative study is discussed with reliability as a criterion, the consequence is rather that the study is no good. At the same time Golafshani (2003, 601) quotes Patton saying that the validity and reliability are two factors, which any qualitative research should be concerned about while designing a study, analyzing results and judging the quality of the study. Lincoln and Guba (1985) argue that the point is not just, how many times the same results can be received by repeating the research, but whether the results of a research are consistent with the data collected.

According to Marshall and Reason (2007, 369), reflection is a key action research quality indicator. Quality becomes having, or seeking, a capacity for self-reflection, so that the full vitality will be engaged in the inquiry. Hence, quality is about becoming rather than being. Reason argues (2006, 187) that in action research quality comes from asking, with others, what is important in this situation? How well are we doing? How can we show others, how well we did? All the comments indicate that the quality of qualitative research is very difficult to define. In this study, the answers of interviews were analyzed immediately and the received answers triggered a need of new interviews to the certain experts. It came up that the environmental managers, who worked in the integrated units, could give interesting and useful information. Thus, that information was used to support the aim of the study.

Reliability and validity are appropriate concepts for attaining rigor in qualitative research. Without rigor, research is worthless, becomes fiction, and loses its utility. Thus, a great deal of attention is applied to reliability and validity in all research methods. (Morse et al. 2002, 1-2.) According to Merriam (1995, 51), rigor is needed in all kinds of researches to insure that findings are trusted and believed. The rigor can be attained in qualitative research by criteria of internal validity, external validity, reliability and objectivity. A great deal of attention was paid to rigor also in this study.

The concept of validity can be applied to every aspect of the research process. It is simplest form validity refers to the appropriateness of each step in the research process. However, the concept of validity is more associated with the measurement procedures (Kumar 2014, 386). According to Graziano and Raulin (2010, 163), external validity refers to the degree to which researcher is able to generalize the results of a study to other participants, conditions times, and places. Furthermore, Merriam (1995, 53) states that internal validity asks question: How congruent are one's findings with reality? Key to understanding internal validity is the notion of reality. McNiff (2011) argues that validity is about establishing the truth value of a claim and researcher has some control over validation processes, by showing the internal coherence and methodological rigor of your claim. (171.) The validity of research means that the right things are researched.

The statements of Patton, Lincoln and Guba (2002) are considered in this study. In those statements are noted that with internal validity there are strategies, which can be used for greater consistency such as triangulation. (228.) When the study was planned, it was paid a particular attention to the selection of interviewees. The interviewees were selected carefully by interviewing experts and the results were analyzed during the research process. According to Mirriam (1995, 56), this kind of process can lead to consistency and internal validity. It also increased reliability of the study.

Triangulation includes demonstrating the authenticity of the data by keeping systematic records of the collected data. It is important to negotiate about the data with others, who are involved in process. They can be agreed that collected data is authentic. And finally to generate evidence from the data, which demonstrate that the truth is told.

According to Flick (2002, 226-227), triangulation reflects an attempt to secure an in-depth understanding of the phenomenon in question. During the study process, there were many discussions about received data with people, who are experts in the environmental information exchange in the company. These experts gave their own opinions, which helped to concentrate on the right things and the right entireness.

Multiple methods were used in this study, since that allows for triangulation. Triangulation created confidence in accuracy. Triangulation was also increasing the reliability of the study. According to Patton (2002), triangulation strengthens a study by combining methods. This can mean using several kinds of methods or data. (247.) The used multiple data collection methods in this study, were open-ended questions, interviews, documentary evidence and observation. The results, which were received by using triangulation, can be regarded reliable, since they all supported to each other.

The literature, which was used to create the theoretical section of the research, included a diversified range of classic and new books, articles of well-known and eminent authors. The literature review is a cross-section of the 20th century literature starting from Claude Shannon in 1945 and continuing to the present day. During the process, it was also viewed the opinions of different authors, concerning the research methods and the valuation of methodologies. These different viewpoints clarified how scientific research has been developed. Action research is still quite a new phenomenon.

4 RESULTS

The results of the empirical study will be presented in this chapter. They clarify the current internal and external information exchange at Metsä Board. First it will be explained, who participated in the research, and where the environmental focus of the research was. Then the actual results will be reviewed more closely. Finally Davenport's (1997) Ecological Model for Information Management will be reviewed including how the results had been derived from the perspective of Davenport's model.

4.1 Environmental Focus of the Research

There are five environmental managers working for Metsä Board. Four of them work for integrated mills meaning that they work for both board and pulp mills. Open-ended questions were sent to all the managers in December 2013 based on these questions the interviews were arranged in the beginning of January 2014 and in February 2014. Since paper board and pulp processes are very extensive and complicated, a decision was made to focus on information exchange between mills and other units. The main focus was on effluent related information exchange, even if the environmental load also includes noise, air emissions, and solid wastes as figure 16 illustrates (Dahl 2008, 10).

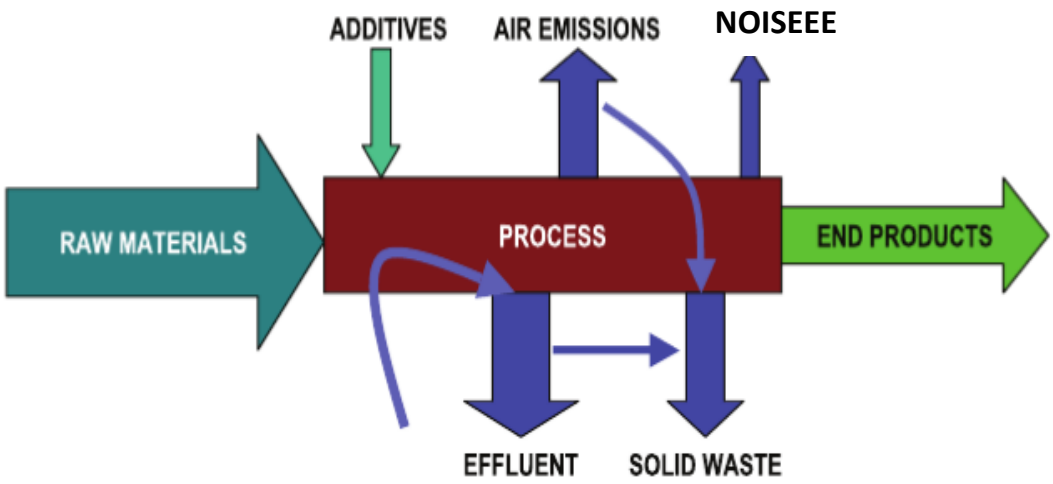

FIGURE 16. The Environmental Load from Process Industry (Papermaking Science and Technology, Environmental Management and Control 2008, 10)

The volume of the effluent from pulp, paper and board production is highly dependent on the amount of fresh water used (Dahl 2008, 13). That is one reason, why also Metsä Group continuously seeks new ways to reduce the use of fresh water. Its newly established target is to reduce the use of process water by 10 % by 2020 (Metsä Group Sustainably Report 2013, 32). Furthermore, when evaluating the effluent load of the pulp, paper and board industry the total volume of effluent is not the key issue, but it is much more important to know the quality of the total effluent (Dahl 2008, 13). Effluent

is a big environmental issue at board mills. Air emissions do not have as a big role at board mills as air emissions have at pulp mills.

Pulp, paper and board mills are usually located alongside lakes or rivers, because water is a vital element to mills' processes. Water usage and effluent (wastewater) treatment have become one of the most important environmental issues. Figure 17 illustrates water flows and recycling in paper and board production. Board and pulp mills have different types of effluent treatment plants for instance biological, chemical, mechanical effluent treatment plants. Mandatory effluent water samples are regularly taken by mills. Those samples are analyzed at the mills, in their own laboratories or the analyzing process is partly or totally outsourced. Metsä Board's mills started a project to reduce water intake and fibre loss, and to make water use more effective. The motto is "making more from less." (Metsä Group Sustainability Report 2013, 32.)

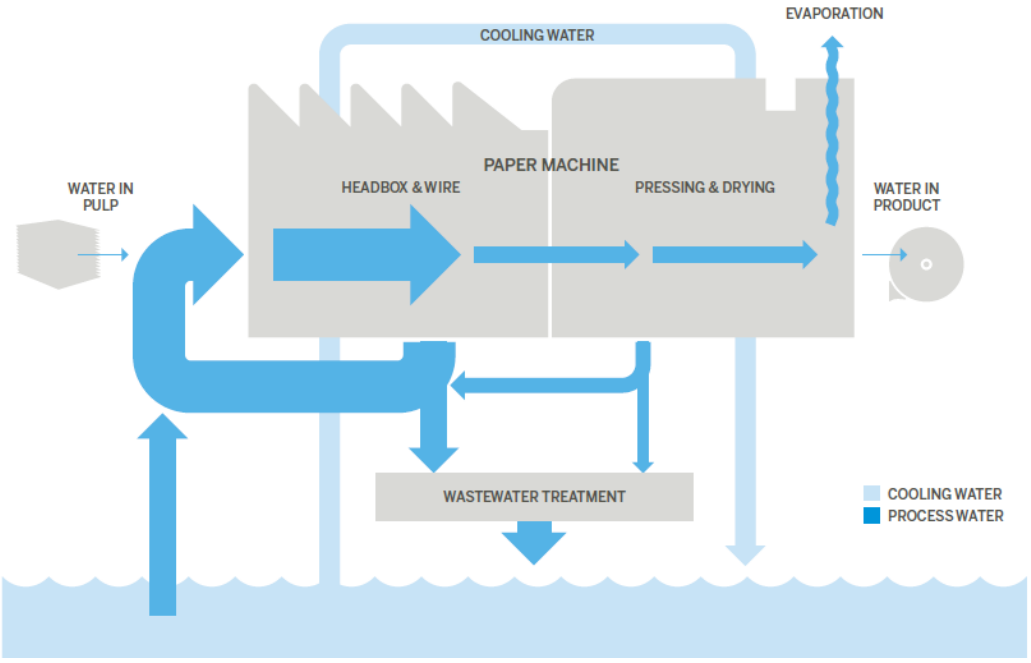

FIGURE 17. Water Flows and Water Recycling in Paper Production (Metsä Group Sustainability Report 2013, 33)

4.2 The Ecological Model and the Research Results

First, it was reviewed an overall environmental information exchange at the mills. Idea was to understand, what kind of internal and external as well as written and oral information exchange there was in the company, and who used the information. According to Davenport's (1997, 175) Ecological Model of Information Management, the relationship between an organizational context of a company and its information environment works both ways. This means that information environment can enable or constrain the organization.

Constantly changing environment, changes in companies and their processes mean changes in the whole information exchange. Metsä Board has faced same challenges and changes as other forest industry companies. Mills have been sold and closed during the last years. Employees have been given notices and processes have been changed, which means that information exchange structure and demands have changed also. The received results of the study showed that improvements are needed. The results also betokened that people are keen to do changes and give proposals for improvements of the information exchange.

The objectives of the study were to answer the research questions. The first question should answer what actions need to be taken to improve the environmental information exchange at Metsä Board. The received outcomes showed that there are many targets to improve. However, there were some targets, which turned out to be especially important. The following actions need to be taken to improve environmental information exchange:

Overall environmental information exchange

The results of the interviews showed that the overall environmental information exchange between the board mills is good. Anyway, sometimes there are situations, when the flow of information exchange could be much better. That is why the assumption is that improvements and actions are needed. It turned up from the interviews that managers do not communicate regularly with other managers, but the communication is more or less occasional. There are arranged meetings for

environmental managers twice a year, but daily basis communication between managers is missing.

Jargon and written notes

There are also situations at the mills, when communication is not understood equally. Even if all the mills are board mills, the used language at the mills can differ. Reasons for that can be mill's own jargon or written notes are unclear or just misunderstandings in communication between people, so changes here are needed.

Information from mill projects to all the mills

Environmental managers said that information exchange was improved lately. But, since it is an area, which is changing all the time, it has to be developed constantly. From the interviews became evident that there should be more information about ongoing mill projects. Even if, a project is implemented only at a certain mill, there are things in project, which concern other mills too. Other mills can receive useful information from those projects. They can utilize that information at their own mill and they can offer their experiences and suggestions to the ongoing projects.

Bigger role for the production meetings at the mills

All board and pulp mills have production meetings in the morning, where the production incidents are discussed before shifts are changed. Some environmental managers suggested that effluent issues should have a much bigger role in the production meetings. According to these managers a quite normal procedure is that the effluent test results are talked through only once a week and not every morning. If some test results or measurements are gone over the permitted level, those are mentioned in the meetings, but no further actions are planned or taken. As mentioned earlier, some of the environmental managers think that Metsä Board's effluent treatment process has got just a small role in the whole production process unlike at Metsä Fibre. Proposal of the managers was that status of the effluent treatment plants at Metsä Board mills should be discussed in the production meetings. Strategic parameters of the effluent treatment plants and results should be checked in the meetings. This practice would help to improve environmental value among participants.

A comparable sample testing

Since functionalities of the effluent treatment plants are different at each mill, it is difficult to compare these functionalities to each other equally. Some mills have their own laboratory, where the effluent analyses are done for their own purposes, so the test results are received daily. Whereas, some mills have outsourced all their sample testing, therefore the results are received only a couple of times per week. This dissimilar procedure causes a situation, where it is not possible to create a similar practice of test analyses to every board mill.

Reliable measurements

The current challenge is how measurements should be done at the mills, so that they would be comparable. The present problem is not only between the mills, but also inside the mills. Measurements of the water consumption are not reliable at all the mills. At least, at one effluent treatment plant the mill's current measuring method gives a wrong picture about the functionality of the effluent treatment plant. The conclusion from these comments is that the measuring methods at the mills should be standardized and they should be made comparable. All the managers, who commented on the topic, are agreed that this problem should be fixed quickly.

Overall know-how

The overall know-how of the mills' processes came up in the interviews. The employees' know-how about the effluent treatment plants at Metsä Fibre is good. The employees understand the whole mill processes including the functionality of the effluent treatment plants, but at Metsä Board only a few employees understand the whole, big picture of the process. This means that the effluent treatment plant is perceived as a separate unit and not as a part of the whole mill processes. This is not a lack of resources at Metsä Board, but above all differences in methods. At Metsä Fibre the whole production organization takes responsibility for environmental liabilities, whereas at Metsä Board just a couple of people look after effluent treatment plant. Furthermore, the expertise at the mills of Metsä Board is very narrow according to some environmental managers.

Diagrams and summaries available to those, who need them

Metsä Fibre regularly prepares monthly diagrams and summaries, which are based on different reports. All these are then saved into Metsä Group's intranet, Collaboration Intranet pages. The production teams and the management teams have possibility to see and use the saved information in the intranet. This useful procedure is missing at Metsä Board side.

Up-to-date reporting systems

Reporting is one of the most important elements in external information exchange. There exist different software and solutions, which are used in preparing the reports. At Metsä Board mills the main, used IT-systems are SAP (Systeme, Anwendungen und Produkte in der Datenverarbeitung Aktiengesellschaft) and MES (Manufacturing Execution Systems).The regular reports, which are prepared for internal use, are the weekly trends, the mills internal monthly reports, the environmental and effluent reports. The reports for external use are reports to Tilastokeskus and ELY-keskus.

Since reporting has a big role in the external and internal environmental information exchange at Metsä Board and Metsä Fibre, the creation of reports should be much easier and quicker than it is now. Most of the interviewed environmental managers think that data collection and filling in reports is too time-consuming and even frustrating at the moment. This is because the same information has to be filled in the different reports. Common findings here are that there are quite many reports, which are very time-consuming to prepare and some of these reports overlap each other. Also the gamut of the used IT programmes is wide, and it differs from mill to mill.

Excel is the programme, which is used in reporting at the mills. The used system is not a very sophisticated system for this purpose anymore. Anyway, there is an ongoing project with a goal to change the excel software to a new programme. In the beginning, only the software will be changed, meaning that only an instrument will be changed, but the structure of the reporting will be kept mostly the same as earlier. This means that no big changes will be expected there. An essential change to the environmental managers is a new interface with a new platform.

Cooperation with the different groups

All managers agreed that the cooperation of the environmental information exchange with the different teams of Sustainability and Corporate Affairs works well. Moreover, the managers were satisfied with environmental managers meetings, which are arranged twice a year. These meetings are well organized, they offer useful information to the managers, and they give a possibility to meet all managers at the same time. These meetings are excellent opportunities to change information between managers.

Information to the top management

One of the most important improvement targets was the transmission of environmental information to the top management of Metsä Board. The top management was missed the meetings where environmental information matters would be handled. This lack of information exchange came up in the meetings, where the researcher was doing observation. It is indisputable that the commitment of all parties in the company would increase the status of environmental information exchange.

Feedback to improve the current practice or create a new practice

Feedback from the external information exchange is missing almost totally. The environmental managers get feedback only, if the figures, which they send to authorities, are wrong. Feedback would be necessary, since without feedback, it is impossible to improve the old procedures or create something new.

4.3. The Results from the Organizational Environment Point of View

When the results are reviewed from Davenport's Information Ecology point of view, the results indicated connection to the Organizational Environment. Davenport's (1997) Organizational Environment is a part of his Ecological Model for Information Management, which was used as a framework in this study. The Organizational Environment contains three components, which are business situation, technology investment, and physical arrangement. Some important elements of the company's business situation are business strategy and business process.

According to Davenport (1997, 176-179), *business strategy* influences the information environment, which is a very broad and ecological web. Metsä Board's strategy focuses on growing paperboard business in Europe and especially in Asia and in North America. Furthermore, the ecological aspects at Metsä Board are taken into consideration in the whole product supply chain. Davenport (1997, 179) accentuates that the business strategy should influence information strategies and tactics. Also company's information environment needs to change as well (1997, 48). Metsä Board's current strategy means that company's organizational and external business environments will be changed, since its focus change.

How work gets done in companies, depends on the availability and the quality of information. According to Davenport (1997, 179), many companies which have decided to change, improve or reengineer their *business processes,* find that they need to change the basic aspects of their information environments. The results of the study showed that many processes can be improved by changing the processes themselves and/or at the same time by improving the information exchange.

Davenport's (1997, 183) model of the information ecology largely stresses components other than *technology*. But Davenport admits that organization's IT does affect its management or the use of information. IT has a very important role at Metsä Board's information exchange. The amount of data, which is received from different parts of the mills' processes like laboratory analyses of the effluent treatment plants, is huge. Since, it is impossible to handle that volume of the data manually, an investment in reporting system was done to improve internal and external reporting. The results also showed that it is useful to have diagrams and summaries in the intranet attainable to all relevant users.

Davenport's (1997) *physical arrangement* means that individuals and groups are located in relation to others with whom they work. Davenport accentuates that it is obvious that people, who need to communicate regularly, should be physically near each other. (186-187.) Since, all environmental managers are located at the different mills, it is important that current practice concerning the environmental meetings remain. All the managers are very satisfied with these meetings and find them very useful.

5 DISCUSSION

First, this study explored, what information actually means and what kinds of theories are linked to it. Clearly, there are many opinions, statements and theories of information. The literature studied, which is discussed in Chapter 2 revealed that there exist some common views for instance information drives our communication and our reactions to the entire environments. If a company wants to succeed in business, it has to ensure that both the internal and external information is the right information reaching the right people at the right time. This was mentioned in Chapter 1 and also that data, information and knowledge are very closely connected to each other and all of them are dependent on each other.

The outcomes of the research with the interviews, observation and documents were in line with each other. Two sets of interviews were carried out as it was mentioned in Chapter 3. The second interviews confirmed the conclusions from the first interviews and also gave new information missing from the first interviews. The second interviews led to making suggestions for improvements. The documentary analyses verified the results of the interviews. By examining the received findings, it was possible to draw conclusions and give proposals for the future research.

The multiple methods used in data collection provided consistency and internal validity. They also increased the reliability of the study. Nowadays there is a lot of data and knowledge of information everywhere. Therefore, it was important in the study to focus on a certain area. Hence, it was focused on the environmental information exchange and the effluent treatment of Metsä Board Finnish mills. The complete generalization of the research findings is not possible, since the investigated board mills have different working methods and effluent treatment plants. However, the differences do not affected information exchange too much. The results show that the main needs of information are very much the same at all the mills.

It is possible that some of the findings of the study are common knowledge, but since the company does not have any research about this area, it was important to

investigate the current procedure properly. Based on the findings of this research, it is now possible to continue the development work and implement improvements.

5.1 Answers to the Research Questions

The objectives of the study were to answer the following research questions:

1. What actions need to be taken to improve the environmental information exchange at Metsä Board?

2. How can these actions be implemented?

When this study was started, there were signs indicating that the environmental information exchange could function better at Metsä Board. A small scale benchmarking was done with Metsä Fibre. The environmental managers, who work at the integrated mills, were able to compare the functionalities between the board and pulp mills. In Chapter 1, it was described the overall challenges of the environmental information exchange faced by Metsä Board. Challenges are diverse being a consequence of the different effluent treatment plants, their different functionalities and the demands of the reporting. An effluent treatment plant is one of the most important parts of mills' processes and its information exchange functionality should work effectively. In spite of differences in the studied mills, there exist many similar challenges at all the mills.

One important objective of the study was to find measures, which could be used to improve the current information exchange in the company. In the next Chapter 5.1.1 there will be explained the main actions, which should be improve and implement.

5.1.1 The Main Actions to Improve and Implementation

There are some common information exchange challenges faced by all the board mills. In Chapter 4.2 it was told the actions, which should be improved now. The actions and proposals for implementation are as follows:

TABLE 1. Actions to improve and implementation

The Main Actions to Improve	Implementation
Safety diary	To write clarification about the environmental aberrations in 'safety diary'. The common instructions, how to fill in 'safety diary'.
Jargon	To standardize mills' jargon. All the mills should participate in the process. Contact person could collect the info, put it together and keep it updated. Information should be in a place, where all the managers have access to.
Information sharing	To arrange more common meetings and forums with the environmental managers. To forward environmental information to all employees and the top management.
Projects	To share information about new and ongoing mill projects with all the environmental managers.
Production meetings	To go through the status of the effluent treatment plants in the production meetings, in the mornings. If further actions are needed, those actions should be discussed and plans done.
Know-how	To train Metsä Board's personnel and also try to change their attitude in the long term.
Reporting	To diminish the amount of reports in general. To combine the internal and external reports, if possible. To develop reporting system furthermore, so that it will be more useful to the environmental managers.
Feedback	To communicate with people/organizations to whom the reports are sent.

All above mentioned actions should be implemented to improve the current information exchange. A good start would be a project plan including all the actions mentioned in above table 1.

5.1.2 Action and Research

Action research was selected as a method, since it enabled the researcher to be personally involved in the process. A benefit of this method was also that a primary purpose of action research is to produce practical knowledge that is useful to people in their daily life. Furthermore, the action research is about working towards practical outcomes, and also creating new forms of understanding. (Reason and Bradbury 2001, 1-4.)

The action part of action research is about improving practice. The research part of action research is about offering descriptions and explanations for what you are doing as and when you improve practice. (McNiff and Whitehead 2011, 7-14.) In this study one of the main aims was to improve the current environmental information exchange in the company. In research part it was found things and come to new understanding of the whole process.

Action research method can be considered a successful choice in this study. As mentioned earlier in this chapter, the method enabled the researcher to be personally involved. Action research can be described as spiral or cycle including plan, observe, act and reflect. It is a systematic process. First, it was examined the areas of information exchange, which did not worked well in the company. After that the right measures were sought to improve the found drawbacks. Finally, it was started to implement those proposals for improvements together with people, who were involved in the process. This process is still ongoing. Some actions have been already implemented according to plan and some actions are waiting for to be implemented.

5.1.3 The Implemented Actions

Since the study started more than one year ago, some of the proposals for improvements have been already implemented. The first implemented action was the environmental responsibility meeting, which was missing at one board mill. From now on, the meetings will be arranged regularly at all the board mills.

The second implementation concerned reporting. As mentioned in Chapter 4.2 reporting has a big role in the external and internal environmental information exchange at Metsä Board. Excel software was used in reporting earlier, but in the beginning of September 2014 a new software SoFi was launched. The new reporting system is still in the development stage, but it should be ready by the end of 2014.

The third and the most important action, which was implemented, was the forwarding of environmental information to the top management at Metsä Board. In Chapter 2.7 was quoted Davenport (1997, 134), saying that if an executive takes charge of the information management it sends a signal to the organization that this is an important area to get right. From now on, there will be Energy and Environmental Quarterly Review meeting four times per year at Metsä Board. In these meetings there will be discussed about the certain environmental information issues.

In the action research spiral of Kemmis and McTaggart (Figure 13) involves cycles like planning; acting and observing; reflecting; acting and observing; reflecting and so on. Planning means a change, after that follows acting and observing, the process and consequences of the change, reflecting on these processes and consequences and then re-planning. In reality the process is likely to be fluid, open, and responsive. The actions implemented at Metsä Board, are now in reflection stage meaning that planning, acting and observing have been done and now reflecting on the processes and consequences is going on. The next step will be re-planning. It is obvious that for instance the reporting system will be developed further after the first experiments are collected from the users. Also Energy and Environmental Quarterly Review meeting is still forming.

Davenport's (1997) information ecology model was used as a framework in this study. In Chapter 4.3 Davenport's organizational environment components were explained more closely. The most important component nowadays is the business strategy, since it influences all the parts of companies' functionalities. According to Davenport (1997, 183), the information ecology largely stresses components other than technology. However, Davenport admits that IT has its role in companies. The researcher opinion is that this is changed since Davenport's information ecology was written. Nowadays IT has a very big role in the information exchange and it will grow even further.

Davenport accentuates that people, who need to communicate regularly should be physically near each other. The researcher partly disagrees with Davenport about this. It is good, if people, who work together, are located in the same place, but it is not necessary. IT has changed this too. The current IT systems make it possible to be contacted each other easily and anytime. So, not matter, where your location of employment is.

5.2 Comparing the Results with the Literature Review

The literature review showed the wideness of information. Information itself has been under scrutiny since Claude Shannon's time in the 1940's. The conducted empirical study verified that information exchange involves many different elements. Hence, the holistic approach to information and information exchange was justified as the literature review showed. Clearly, the literature showed that it is not possible to do just one thing in the information exchange process to succeed, but it often demands the involvement of people, know-how, time and device.

The results showed that the emphasis of information exchange is not on technology, but human activities. Furthermore, the results showed that the technology had a bigger role in the researched subject than it is in Davenport's information ecology model. Technology offers many benefits, but technology cannot think for us. Technology offers us tools, but people are those, who make decisions and execute them with technology.

The empirical study showed that each board mill is its own, individual unit. The closer contemplation of the mills showed the differences between them. For instance none of them has exactly the same, identical effluent treatment plant, even if the process itself is technically the same. The functionality of the effluent treatment plants differs at least a little bit from each other. This individuality arouses different needs for the information exchange at mills. Anyway, the needs of all the mills after all are the same. The whole structure is supported by Davenport's theory, when he states that the information environment is very complex, especially in big organizations (1997, 32).

One of the information Davenport's ecological attributes is an integration of diverse type of information. The empirical study was in line with that. It showed that the exchange of diverse information is necessary between managers, so that they can keep up with their work. The integration of various types of information includes information from outside and inside the company meaning information from the laboratory analyses, production meetings, Sustainability and Corporate Affair personnel and information exchange between other managers.

In the real life the change is continuous meaning that the information ecology changes and information systems have to be flexible. The empirical study supported these findings of the literature review. At the moment the information flexibility of the reporting at Metsä Board is limited, but changes are going on.

In the past, the focus of information was on the production and distribution of information. Now the focus is moved to people and information behavior. When focusing on people in the ecological management, it means providing information, observing people and facilitating the effective use of information (Davenport 1997). These same subjects came up from the empirical study. The environmental managers are those, who collect and fill in data into the systems and who provide information. So, there is constantly internal and external observation going on.

The literature review showed that good information creates value and it has to be collected from the variety sources to get all the relevant pieces of information.

According to Davenport (1997), the complete information contains all the important facts. In the concrete, the empirical study showed that many measurements of the effluent treatment were collected from the different locations. All these measurements created value for internal and external use. Drawback here was that results of the measurements were not comparable between the different mills. Reason for that were different functionalities and different measurements' points and/or manners in effluent treatment plants.

Technology is not enough for success, because information ecology is mastering the information and knowledge environment (Davenport 1997). This literature review was in line with the empirical study. The holistic approach of information exchange was shown clearly in the information environment components as strategy, staff, culture/behavior, politics, architecture and process.

One component of Davenport's information environment is information politics. Davenport (1997, 68) emphasizes that addressing information politics frankly is what matters for the information ecology. It is also important to talk honestly and directly about the political nature of information in companies. Metsä Group has a communication policy, which is applied in all of its companies. The key goal of the policy is to manage and support Metsä Group's internal and external communication and corporate image development.

Metsä Group has also published its environmental policy and information security policy. In the environmental policy Metsä Group is committed to promoting sustainable development, to continuously improving its operations and to conducting its business in a responsible way. Information is one of Metsä Group's competitive business assets, and it is considered important for effective business management. Information is essential to an organization's business. Hence, it needs to be protected. The actions, which have been executed in Metsä Group, are in line at least in theory with information ecology of Davenport. Davenport accentuates that information politics should be discussed openly in organization and the information entities to be managed centrally are clearly defined in organizations (Davenport 1997, 82).

Information behavior in the information ecology means, how individuals approach and handle information. This includes searching for it, using it, modifying it, sharing it, hoarding it, and even ignoring it. (Davenport 1997, 83.) All these actions were found at the work of the environmental managers, especially when they created reports. They had to find the right data. They used the same data in different reports, presentations and meetings. Sometimes there was data, which was not essential to store. This was an area, where Metsä Board could improve its practice. There existed a lot of environmental information, which could be shared, handled and modified much wiser. A well-defined plan is needed. The plan should include the needed information, the time when it is needed and who is needed it.

The western firms opposed to Japanese usually restrict information sharing within the corporation. However, some firms have found that sharing information with business partners or competitors has distinct advantages. (Davenport 1997, 89.) The similar comment was received from one environmental manager, who has possibility to participate in forum once a month with 'competitors'. In these forums, it is possibility to share experiences and discuss about the current business issues. This kind of information exchange gives opportunities to widen point of views in this way develops the whole business. It would be a desirable opportunity to all area environmental managers.

5.3 Limitations

The most considerable limitation of the research was the dissimilarity between the focus mills. The target was to study the environmental information exchange at Metsä Board Finnish mills with the main focus on information exchange of the effluent treatment plants. The received information was not totally comparable, because the mills are doing different measurements depending on their processes. This difference did not affect the final results of the research much. Furthermore, some of the mills are so called integrated mills, where the board mills and pulp mills are formed one unit and this complicated comparison too.

The challenge of the study was to focus on the right information area. Information has many different components including the information logistics, the information knowledge, the information science, the information technology, the information ecology and so on. As mentioned earlier, this study concentrated on the information ecology, which is used as a framework here. The information ecology already is itself a very wide area, but it gives a comprehensive picture of information in our environment. The information ecology was considered the right framework, since the research area was quite broad and diversity, therefore it was logical to take a holistic approach to information (Davenport 1997).

The obvious limitation was also a lack of wider benchmarking. The benchmarking was done inside Metsä Group, but was not done outside the company. The main reason for that was a lack of time and also the missing connections to the other companies.

Different functionalities of the mills' effluent treatment plants bring challenges to the environmental information exchange. At the moment there is no possibility to measure the same things by using exact the same methods at each mill, meaning that the measured results will not be comparable. Investigations and possibly financial investments are required to improve the current situation.

There was a possibility that some opinions of the interviewees were too positive. There was also a possibility that the environmental managers gave a palliative picture of the functionality of the information exchange in the company. Furthermore, some of the environmental managers did not give any new ideas or proposals for improvements, even if they thought that there were objects to be changed.

Even if there were some limitations, the chosen topic of the study is highly important here and now. It is possible to see consequences daily, if environmental information is missing or it is insufficient in the big organizations. This study gives a base for further studies. It also answered the research questions by indicating the main actions, which have to be improved and implemented in the environmental information exchange.

5.4 Recommendations for Future Research

The study gave an opportunity to compare the environmental information exchange between the board mills and the integrated mills. It also gave a wider perspective about the processes and practices at mills. The environmental managers, who work at the integrated mills, were able to shed light on that side. It was also possible to do a small-scale benchmarking. The benchmarking gave useful information of the current environmental information exchange at Metsä Fibre. It also made possible to make comparison between the environmental information exchange of Metsä Board and Metsä Fibre. Even if the environmental issues were different at the pulp and board mills, the basic elements were the same.

Pulp mills are raw material producers, which use hazardous chemicals in their processes. If those chemicals get out to the environment, they can cause a catastrophe. Furthermore, air emissions have bigger role at pulp mills than at board mills. Based on Metsä Fibre's information, it was easier to understand the current information exchange process of Metsä Board and see areas, where the improvements were needed. To get even more detailed and broader picture of the information exchange, a benchmarking with external companies is needed.

The study showed that it is necessary to improve the environmental information exchange at Metsä Board mills. This means external and internal improvements. The external changes are difficult, because the environmental managers' possibilities to affect the authorities are limited. Proposals for improving the current situation is to clarify first all regular reports, what authorities are demanding from Metsä Board and then based on the clarification, rationalize the process. Maybe there is a possibility to reduce amount of reports by combining them. Obviously this needs discussions between the authorities and the environmental managers.

The internal changes are easier to execute. The main problems are differences between mills' processes and peoples' opinions. Another clarification, which should be carried out concerns the information exchange from the operation level to the management level. The main point is that information should be useful, up-to-date and important to

the top management. The new information of information exchange should give added value to the management. If the management of Metsä Board gives its blessing to the operation of the environmental information exchange, it would guarantee the success of the operation in the future.

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APPENDICES

Appendix 1. Questions for the Interview, All Mills

Interviewees: Environmental Managers

Tuesday 3 December 2013 at 10 a.m. Time: 50 minutes

Monday 13 January 2014 at 10 a.m. Time: 60 minutes

Thursday 23 January 2014 at 2 p.m. Time: 55 minutes

Friday 10 January 2014 at 10 a.m. Time: 1 hour and 10 minutes

Tuesday 4 February 2014 at 10:30 a.m. Time: 1 hour 30 minutes

1. Do you have cooperation with other environmental managers?

What kind of cooperation do you have, if you have any?

Is there need for changes for the current situation?

Do you have proposals for improvement at the moment?

2. How does the information exchange work inside the company (between different units, mills)?

Do you have new ideas to improve information exchange or change it?

3. What reports are you doing at the moment concerning effluent handling?

Do you create only compulsory reports and to whom?

Who are using those reports?

Do you get any feedback from those reports?

4. What kinds of effluent measurements and other water measurements exist?

5. What is worth measuring to get comparable results of effluent?

Or is it so that systems have to be changed before any comparable results will be received?

6. What is your opinion? Should there be changes in the current operation models (reporting, information exchange, meetings of environmental managers etc.)?

7. What are the current applications, which are used at the mills (MES, SAP, ERP...)?

8. What kind of cooperation do you have with Metsä Group environmental teams?

Appendix 2. Questions for the Interview, Integrated Mill 1

Interviewee: Environmental Managers

Monday 14 April 2014 at 9:30 a.m. Time: 15 minutes

1. You have to prepare many reports on the environmental matters. How do you exploit these reports at your work?

2. Are there procedures at Metsä Fibre, which can be also utilized at Metsä Board? Or exit there any other things, which would advance the present functionality of Metsä Board?

3. There will be a new programme, which will replace the current excel-program. Do you have any idea, how the new software will operate?

4. What kinds of reports you prepare on environmental matters to Metsä Board and to Metsä Fibre?

Appendix 3. Questions for the Interview, Integrated Mill 2

Interviewee: Environmental Managers
Monday 7 April 2014 at 1:00 p.m. Time: 17 minutes

1. You mentioned earlier that there are differences in procedure between Metsä Board and Metsä Fibre. What is your opinion? What should be done to get closer to Metsä Fibre 'model'?

2. What should be done to increase the value of environmental issues in meetings (production meetings, monthly meetings, production management meetings and so on)?

3. Are there procedures at Metsä Fibre, which can be also utilized at Metsä Board? Or exit there any other things, which would advance Metsä Board's present functionality?

4. The environmental managers do not normally get any feedback from the reports they prepared. Do you want feedback from the reports and what kind of feedback?

5. How do you utilize the reports at your work?

6. There will be a new programme, which will replace the current excel-program. Do you have any idea, how the new software will operate?

7. What kinds of reports you prepare on environmental matters to Metsä Board and to Metsä Fibre?

6. Do you have wishes concerning the new reporting system?

Appendix 4. Questions for the Interview, Integrated Mill 3

Interviewee: Environmental Manager

Monday 7 April 2014 at 2:00 p.m. Time: 20 minutes

1. You have to prepare many reports on environmental matters. How do you exploit these reports at your work?

2. You mentioned earlier that you would like to have a technical monthly report from one Metsä Fibre mill. Do other Metsä Fibre mills have this report?

3. Are there procedures at Metsä Fibre, which can be also utilized at Metsä Board? Or exit there any other things, which would advance Metsä Board's present functionality?

4. There will be a new programme, which will replace the current excel-program. Do you have any idea, how the new software will operate?

5. What kinds of reports you prepare on the environmental matters to Metsä Board and to Metsä Fibre?

6. Do you have wishes concerning the new reporting system?

Appendix 5. Questions for the Interview, Integrated Mill 4

Interviewee: Environmental Manager
Monday 28 April 2014 at 11:40 p.m. Time: -

1. You said earlier that the information exchange between Metsä Board mills does not work well. Do you have ideas, how to improve that? What kind of procedure Metsä Fibre has? Would it be possible to use the same model at Metsä Board?

2. According to you, yearly meetings would be good. Can you please specify? Do you have suggestions, what subjects should be discussed in these meetings?

3. The environmental managers do not normally get any feedback from the reports, which they prepared. Do you want feedback from reports and what kind of feedback?

4. How do you utilize the reports at your work?

5. At the mill, where you work there are no environmental responsibility chain meetings as other Metsä Board mills have? Have you already agreed that it will be arranged regularly also at 'your' mill?

6. There will be new software, which will replace the current excel-program. Do you have any idea, how the new software will operate?