MASTER'S THESIS

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Harmonization of significant environmental aspects and their environmental risk assessment in UPM paper and pulp mills

UPM Kymmene Oyj

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ABSTRACT

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Keywords: Environmental aspects, risk assessment and harmonization.

The purpose of this research is to create harmonized structures for the significant environmental aspects and environmental risk assessment elements of United Paper Mills' (UPM) pulp and paper mills. This would enable setting common goals and analysis methods for the corporation's units. The harmonization process is a part of the development of UPM's environmental management system. The Environmental Management System (EMS) development converges with the development of the company's integrated management system. In addition, this thesis examines the efficiency of the Environmental Management System, using environmental performance indicators. The last part of this thesis is a case study that looks into the integration potential of the different risk assessment systems within UPM. Integration would enhance the interaction and synergy benefits among units and thus would enhance the intensity and usability of the risk assessment system.

The proposal for harmonized significant environmental aspects and risk assessment parameters is based on three examples studied in the thesis. The research was based on interviews, literature, the material of Price Waterhouse Cooper's (PWC) EMS research 2001 - 2003 and the writer's own conclusions. The basis for continuous development is organizational learning; amongst individuals as well as amongst and within different production units. Developing organizational learning would create the potential to enhance the utilization of intellectual property, such as environmental knowledge, in the most efficient manner.

The most important results of this research are the proposals for the harmonization of significant environmental aspects and the defined components of environmental risk assessment system. The defined risk assessment components and scales are established for the probability, consequences and classification of risks. The results of the case study set the groundwork for the integration process between two risk assessment systems.

TIIVISTELMÄ

Tekijän nimi: Markus Talka

Työn otsikko: UPM:n sellu- ja paperitehtaiden merkittävien ympäristönäkökohtien ja riskienhallinnan harmonisointi

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Avainsanat: Ympäristönäkökohdat, riskien arviointi, harmonisointi.

Työn tavoite on harmonisoida yhtenäiset rakenteet UPM:n paperi- ja sellutehtaiden merkittäville ympäristönäkökohdille sekä niiden ympäristöriskienhallintajärjestelmille. Näin saavutetaan yhteneväiset tavoitteet ja analysointikeinot yrityksen yksiköille. Harmonisointiprosessi on osa koko yrityksen ympäristöhallintajärjestelmän kehittämistä. Ja konsernin EMS -prosessi puolestaan konvergoi konsernin integroidun johtamisjärjestelmän kehitystä. Lisäksi työn tapaustutkimuksessa selvitettiin riskienhallintajärjestelmien integroitumispotentiaalia. Sen avulla saavutettaisiin paremmin suuren yrityksen synergia-etuja ja vuorovaikutteisuutta toimijoiden kesken, sekä parannettaisiin riskienhallintajärjestelmän mukautuvuutta ja käytettävyyttä.

Työssä käsitellään kolmea esimerkkiä, joiden pohjalta tehdään esitys harmonisoiduille merkittäville ympäristönäkökohdille sekä riskienhallintajärjestelmien parametreille. Tutkimusongelmaa lähestytään haastattelujen, kirjallisuuden, yrityksen PWC:llä teettämän selvityksen sekä omien päätelmien avulla. Lisäksi työssä esitetään ympäristöhallintajärjestelmän tehokkuuden todentaminen ympäristösuorituskyvyn muuttujiin suhteutettuna. Pohjana jatkuvan kehityksen päämäärälle on organisaatio-oppiminen, niin yksittäisen työntekijän, tiimien kuin eri yksiköiden kesken. Se antaa sysäyksen aineettoman omaisuuden, kuten ympäristö-osaamisen, hyödyntämiseen parhaalla mahdollisella tavalla.

Tärkeimpinä lopputuloksina työssä ovat ehdotukset harmonisoiduille merkittäville ympäristönäkökohdille sekä ympäristöriskienhallintajärjestelmän määritetyille komponenteille. Niitä ovat määritelmät ja skaalat riskien todennäköisyydelle, seurauksille sekä riskiluokille. Työn viimeisenä osana luodaan pohja tapaustutkimuksen avulla Rauman tehtaan jätevedenpuhdistamon kahden erilaisen riskienhallintajärjestelmän integroitumiselle.

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LIST OF ABBREVIATIONS

BAT	Best Available Technology
CSR	Corporate Sustainability and Responsibility
COD	Chemical Oxygen Demand
EMAS	European Community Eco-Management and Audit Scheme
EMS	Environmental Management System
H&S	Health and Safety
ISO	International Organization for Standardization
LCA	Life Cycle Assessment
PWC	Price Waterhouse Cooper's (Consulting Company)

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Markus Talka

In Helsinki 20th of April 2007

1. INTRODUCTION

This thesis outlines a part of the process to upgrade the environmental management system of UPM pulp and paper mills in Finland. It gathers and analyzes information and sets the proposal for the research problem: harmonization of the significant environmental aspects and risk assessment.

This thesis presents an approach to harmonize the significant environmental aspects and environmental risk assessment elements. These harmonized elements are solid structure to possibly build an integrated risk assessment system in UPM. Corporate-wide environmental targets could be set by setting the uniform significant environmental aspects.

The future state of recognized environmental risk management would include the management system, which integrates risks assessment in one unite form by combining environmental, chemical, health and safety, financial and image issues. Information would be available for many people over business units. In addition, the integrated risk management system would be easily linked to whole corporation's general management system. The idea in nutshell is to gather large amount of information from one interface, in less effort. This would be an "engineer's" systematic approach to analyze risks logically, and it may result in less accidents and hazardous emissions from operation.

1.1 UPM in a nutshell

UPM has five divisions, which are Fine and Speciality Papers, Magazines, Newsprint, Label Division (Raflatac) and Wood Products. In addition, there are several Group level functions; i.e. forestry & wood sourcing, energy, IT, logistics, global sourcing and environmental affairs & CSR. The research study of this thesis has evolved in close reaction with the development of UPM's environmental management system (EMS), platform and its common umbrella.

At the moment UPM has 21 paper mills in eight countries and all of them have ISO 14001 certification systems. All paper mills in Europe have EMAS, except Shotton in UK. Each mill site operates according to their own approaches of environmental management sys-

tems based on different standard base and history of mill sites.

UPM is one of the world's leading manufacturers of printing papers. In magazine papers it is clear market leader. In 2006 UPM's sales were € 10,022 billion. UPM's environmental target is to be among the best and most attractive company in its sector of industry. UPM has production units in 15 countries and its products are sold worldwide. The biggest markets are Europe, which accounts for some three-quarters of sales, and North America, which represents about 14% of sales. Most of UPM’s products are sold largely through its own sales network. The most important customers are newspaper and magazine publishers, retail chains, paper merchants, paper converters and the building industry. UPM’s shares are quoted on the Helsinki and New York stock exchanges. (UPM 2006a, 2007a)

1.2 Why harmonization is needed?

The main reasons for harmonization process in company are:

1. Significant environmental aspects have not been defined and assessed equally among mill sites – they are not comparable.
2. "If the environmental aspects and responsibilities of a new, more centralized operating model for UPM are not described in existing mill management systems then these mills risk loosing management system certification." (UPM, 2007b)
3. Environmental risk assessment elements have not been defined and assessed equally among mill sites – they are not comparable.
4. Mill sites which have been examined in this thesis have different elements integrated in their environmental risk assessment system, including chemical, financial or human risks.
5. Approaches between environmental risk assessment and health and safety risk assessment have fundamental approach differences and integration possibilities within these systems have to be screened.
6. Group-wide target setting and information comparison could be possible by harmonized elements – in environmental risk assessment and significant environmental aspects.

7. The upgrade of environmental risk assessment is needed for paper and pulp mills environmental permit – excellent timing to harmonize practices within the company.

1.3 Research scope and objectives

Scope of this thesis is to focus on UPM's mill level management. The aim is to carry out a study, and make a proposal to harmonize significant environmental aspects and their risk assessment among the mill sites. A part of the data has been collected from PWC research done for UPM in 2001-2003. The data for this study mainly exists, but it needs updating and additional analyzing to form a basis for the harmonization process. Basing on the results of a case study in effluent treatment plant, the elements of integrated risk assessment system have been examined. During the work, the importance of analyzing environmental aspects thoroughly but still sensitively has become evident. On the other hand, the uniqueness of each production site and related legislative requirement must always be taken into account.

The target of this thesis is to find a uniform approach on significant environmental aspects and a uniform definition of scales in environmental risk assessment system. This thesis gives a proposal of an integrated risk assessment system option by a case study in one pilot mill site, Rauma. The integrated risk assessment proposal establishes the useful structure of risk assessment system framework. One benefit of this thesis is that this research can be used as a solid analyzing tool by each mill's environmental managers. In addition, the results can help in linking a lower level management to high-level executive management of the Group, and it can enhance interaction of information in each level's management. If all paper mills would find the best solutions and practices for their risk assessment systems within the company, then many synergy benefits would be established for the whole Group.

1.4 Structure of the study

This thesis does not have literature review, because articles and scientific research on this topic was negligible. The information which has been established in chapter two outlines the potential to gain benefit from learning new things and practices. It is the base for harmonization process. Chapters 4, 5 and 6 form the empirical part of this study (Figure 1.1). It is the main focus area. Amount of information in chapters two and three is vast, but in the chapters four, five and six it is more outlined and practical results are represented.

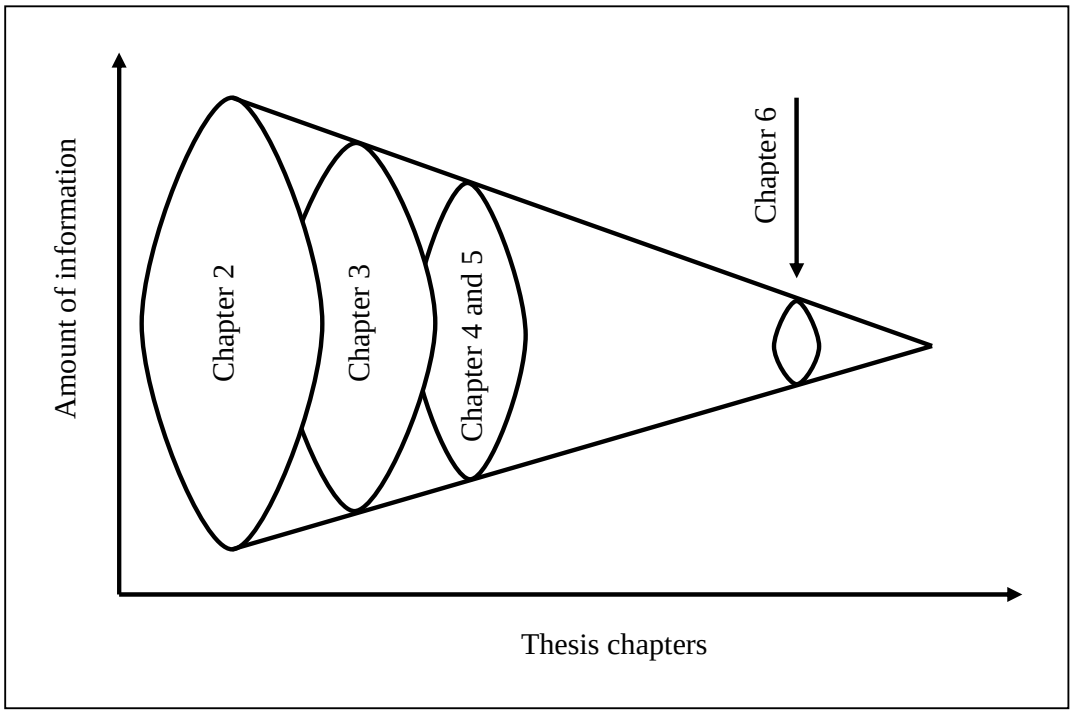

Figure 1.1 Information funnel in this study

The intellectual framework of this thesis is presented in Figure 1.2. The core of the study is mill level dimension and their linkages. The most important elements in mill level are environmental management system and environmental risk management. The total outcome should be the minimal environmental impact from each production unit. Idea of the framework in Figure 1.2 is presented in different chapters as a smaller and focused form to give informative and well-defined picture of the structure of the thesis.

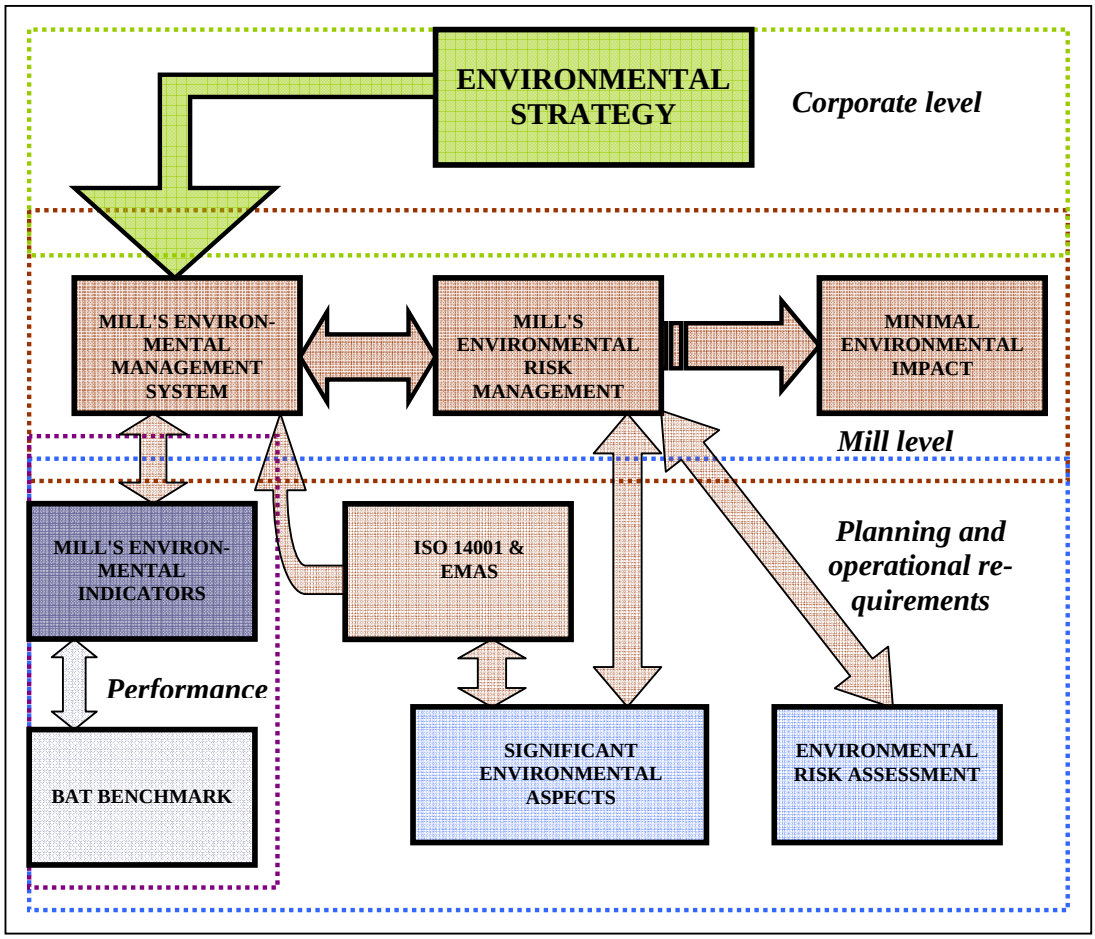

Figure 1.2 The structural framework of the thesis

2. MANAGEMENT OF LEARNING AND KNOWLEDGE IN ENVIRONMENTAL ISSUES

The focus of this thesis is in one hand to harmonize the paper and pulp mills environmental management systems elements and their risk assessment elements with each other. On the other hand, it seeks to create more interaction and stronger linkages between the functions and the various mill sites, such as environmental affairs and occupational health and safety. Relevant questions could be set to emphasize the outline of this intellectual organizational learning process:

- What would be the benefit of the development of company's environmental management system?
- Why is integration of risk assessment considered important?
- How could company use their synergies and interaction in most efficient way in environmental issues?
- Why harmonization has not been done earlier?
- What "hinders" the Group-wide uniform elements formation?

The greatest steering force in continuous learning is the intent to learn and upgrade the prevailing methods, systems and elements. Starting point for harmonization is the learning process and its impact would be – continuous development. The harmonization processes of environmental issues are only narrow part to create a holistic understanding in corporation's actions and businesses. This chapter is a base for this research from intellectual point of view. The answer for questions above in nutshell is relatively complex, but still understandable. The UPM organization is not working as efficiently as possible, because of many fictional barriers among the network of organization. An effective organization could use their knowledge, skills and the synergy benefits as efficient form as possible and maintain the learning process, for example in environmental matters. The effectiveness may not happen, if the barriers exist among organization. Therefore, the upgrade of Group's EMS is a step towards more efficient management framework, and the harmonization process is one part of the EMS process.

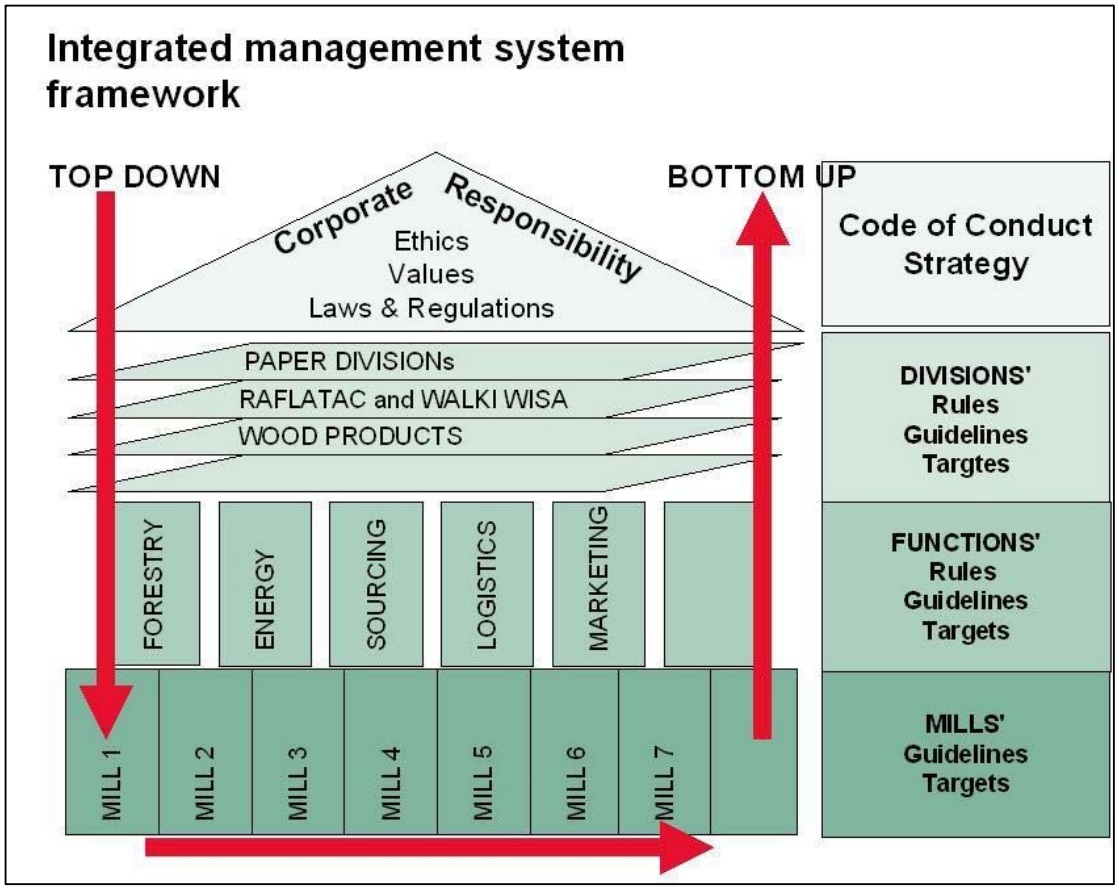

Figure 2.1 Integrated management system framework

Figure 2.1 presents the basic idea of environmental management system concept within the Group. The red arrows symbolize the continuous development procedure. They emphasize that top management ideas are delivered to lower levels, and at the same time the executive management receives and adapts the information from mill sites management processes. Arrows symbolize the cyclical process of combining the tacit and explicit knowledge within the corporation. In this thesis, horizontal arrow is the focus area. It emphasizes the interaction and common targets between the mill sites. One key issue of this thesis is to establish the harmonized approach for common UPM practices and procedures to complement and support local management system. One correction to content of Figure 2.1 is the sale of Walki Wisa Group to Finnish private equity investment company CapMan in 26th of February 2007 (CapMan, 2007).

2.1 Effective utilization of resources in environmental issues

This chapter approaches the research problem from a wider point of view. Still, it gives inevitable information to enhance environmental management in company. One approach to enhance company's competitive advantage could be succeeded by managing company's dynamic capabilities. As Tidd et. al. (2002. p.81) have defined the dynamic capability, "this source of competitive advantage, dynamic capabilities, emphasizes two aspects. First, it refers to the shifting character of the environment; second, it emphasizes the key role of strategic management in appropriately adapting, integrating and re-configuring internal and external organisational skills, resources and functional competencies towards a changing environment." (Tidd et. al., 2002. p.81)

In this thesis's, the dynamic capability could be defined in environmental issues framework as cost efficient resource utilizing potential. The dynamical capability term has only intellectual contribution to environmental matters, and it does not directly refer the characters of dynamical capability in business sense. The first part of the definition above could be seen as in recognizing and updating the company's observed common environmental legislation, environmental performance and risk and environmental management to as applicable form as possible. Aim of the company is demanding, as it is said in (UPM, 2006b. p. 2), "goal of being one of the most attractive companies in our industry." The second part of definition about dynamical capabilities, are in this thesis framework to find the proper and effective tools in changing surrounding environment and steer operations in right direction. The Group's environmental management system development and harmonization processes contributed to the development are good examples to steer operations towards right direction. Hence, the dynamical capabilities in nutshell could be considered to take the most advantage of available resources and own markets in currently highly competed markets. The dynamical capabilities give a chance to predict the forthcoming changes and to be prepared for these changes. In environmental issues, it could be understood as preparedness of tightening emission standards, enhancements in energy efficiency, more efficient raw material usage or more efficient and compact environmental management system and risk assessment, for example.

The main ingredients in corporate strategy are defined as follows: "The strategic dimensions of the firm are its managerial and organizational processes, its present position, and the paths available to it. By managerial processes we refer to the way things are done in the firm, or what might be referred to as its routines, or patterns of current practice and learning. By position, we refer to its current endowment of technology and intellectual property, as well as its customer base and upstream relations with suppliers. By paths we refer to the strategic alternatives available to the firm, and the attractiveness of the opportunities which lie ahead." (Tidd et. al., 2002, p.81)

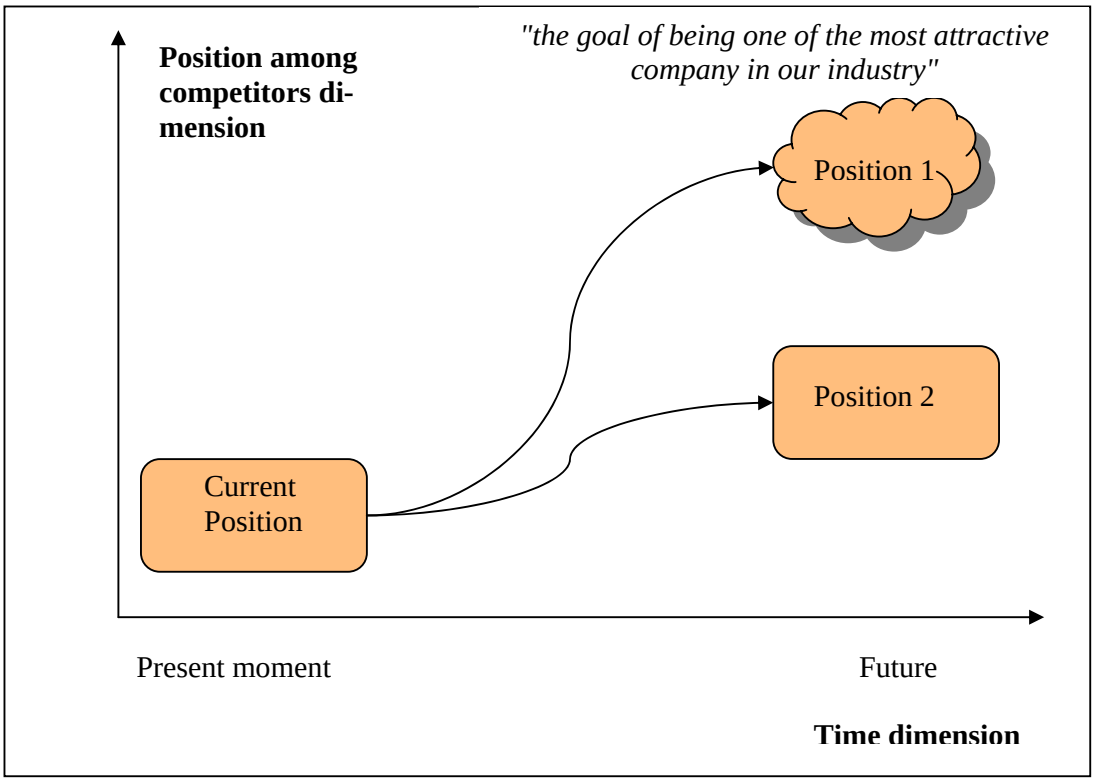

Figure 2.2 Position among competitors and path dependency

Figure 2.2 presents elements about the taking most advantage of dynamical capabilities in environmental issues which has been described before. Path dependency describes the intellectual framework to manage environmental issues. From environmental issues point of view, company's operations are relatively path dependent and possible results of right decisions could be succeeded in the long run. Good examples are; to prepare in future envi-

ronmental, as soon as possible or to focus on issues, which may affect positively on energy usage in each mill site. The paths establish the lines between the boxes and they symbolize the environmental strategic choices, which would enhance the processes to achieve set objectives. There would be many opportunities for company to choose where they want to end up in environmental issues. Figure 2.2 symbolizes the position 1 well; the goal of being one of the most attractive company in the industry. It could be seen as a favourable and ultimate challenge. For reaching the goal, the right choices need to be taken. The tools to achieve this ambitious goal would involve more interaction within the organization, cooperation, transparency and the will and commitment to learn new things and practices. In this thesis the harmonization processes of defined elements would be partly better utilization of intellectual property. The position 1 symbolizes the innovative, ambitious and creative organization, which uses their strengths and opportunities as effective as possible. And integration process in Group's management system is a good example of development. And it may result in better performance and resources use. Position 2 in Figure 2.2 emphasizes the path of a mature organization. In that position, people do not see the potential of available possibilities and people are not aiming to the same target. And the company does perform as efficiently as possible. In that sense, the large company's benefits have not been utilized in a best possible way.

Setting the framework for environmental issues, the company's risk management is tightly connected to environmental management. The Group's risk management team has described the better risk management performance as a competitive advantage: "The objective of risk management at UPM is to enable the Group to accept and manage risks better than its competitors. Management of rewarded risks is seen as a competitive advantage for UPM. For unrewarded risks, i.e., risks that have only downsides, UPM strategy is to cost-effectively mitigate risks to an acceptable level" (Huovinen, 2007). A competitive advantage is understood here as more efficient operations within Group. Nevertheless, the clear target has been pointed out by the risk management team in the UPM.

Consequently, the understanding and knowledge in organization does exist, but the effective tools to utilize the intellectual property as effectively as possible are missing. The

harmonization process in environmental and risk assessment issues are only one part of continuous learning process and towards to greater achievements in the future.

2.2 The organizational learning process

Figure 2.3 establishes the *Main elements of learning through alliances*. They are structured as:

1. Motives
2. Technology/knowledge
3. Organization
4. Design of alliance
5. Learning

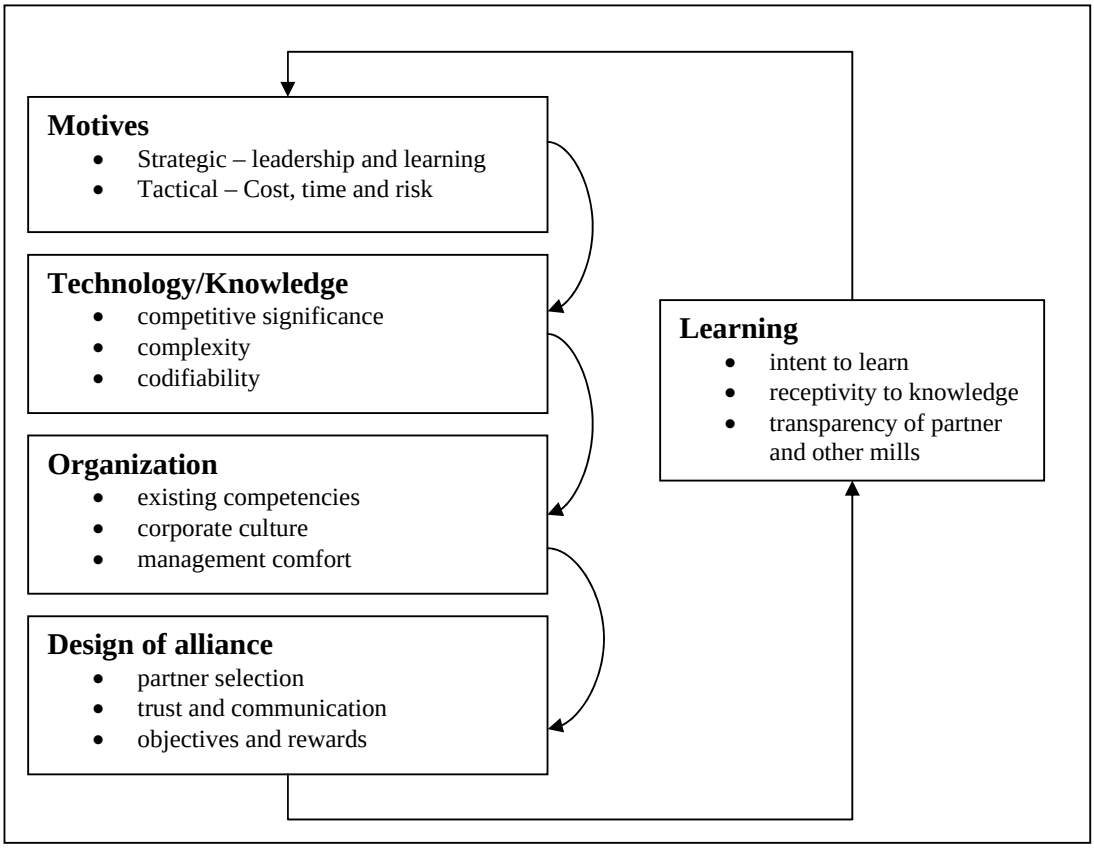

Figure 2.3 Main elements of learning through alliances (Tidd et al., 2002)

Main elements of learning through alliances sets the theoretical point of view to structure five steps in collaboration issue (Tidd et. al., 2002. p.197). The collaboration in this study means the team work between each mill site in environmental issues, for example. Within the vast corporation involves a lot of information, but it has to be shared with as many people as possible. Core persons in this context are the defined responsible persons in environmental management of each mill. A good intellectual framework which promotes this learning process, is *"systems intelligence"*. *Systems intelligence* research outlines systems inside of systems (Hämäläinen & Saarinen, 2006). We could assess the question, how systems intelligent are we? And this has a strong contribution to learning process of individual persons and organizational systems as well. The *systems intelligence* research rely on the framework; we have to find from our everyday life and from surrounding micro sociological networks relating possibilities, which opens the route to more efficient manners to work together better – better for ourselves and better for the unity where we are belonging to (Hämäläinen & Saarinen, 2006).

Different issue and a long discussion would be which unity or identity people would feel that they belong to? Is it a nationality, a region, a mill site or Group called UPM? Even though this may seem to be a quite abstract contemplation, it is relatively important issue as a part of organizational learning. And question should be assessed where people would feel belonging to?

2.2.1 Motives for team work

First part of the *Main elements of learning through alliances* is motive from strategic point of view and in the scope of this thesis is environmental strategy of UPM. That sets guidelines and rules for whole company's operations. Enhancements in harmonization of risk assessment systems do not directly reduce the risks, but it enhances the interaction of the information by sharing the best practices within the company. Thus, reducing possibilities for the identified risks and managing them by a uniform approach within the production units would result in positive impacts. Besides, savings in costs, time and money would be fruitful results for any company. In some occasions, it can hard to point out the savings in costs and link it to the environmental performance or risk management of the company.

The investments in environmental issues are always investments for the future and have positive financial benefits in the long run. And in strategy sense, the company has to use more efficiently the synergies of a big company and harmonization is one part of it.

2.2.2 Technology and environmental knowledge within the company

Second part of the *Main elements of learning through alliances* is technology and environmental knowledge. This would be contributed in the scope of this thesis as a good environmental performance of a company which has strong contribution to environmental knowledge within the company. The environmental performance links well the effectiveness of environmental management and risk assessment in company. The relevant part of technology and environmental knowledge framework is the complexity and codifiability of information. That would result in many forms, for example the different definitions of environmental aspects and different definition and scaling of risk assessment parameters and elements. One suitable approach to reduce complexity and codifiability would be the harmonized significant environmental aspects and environmental risk assessment system, and the integration process of other defined risk assessment elements in the future.

2.2.3 Effective organization

Third part of *Main elements of learning through alliances* is organization. The existing competences must be identified. If the company cannot use their own core competences as effectively as possible, it does not use its strengths and opportunities well enough. One of these core competencies could be the best known practices in environmental issues within a company. On the other hand, the integrated risk assessment system would give organizational smoothness, which could result in better performance.

Pulkkinen (2006) explains the term *systems intelligence* in organization context and he examines the case Linux and how it was created. His conclusion was that the project or organization consisting of vast and motivated volunteered group of people, as self organized community which communicates continuously, operates inevitable more efficiently compared to a conventional organization. This was the corner-stone in Linux operating system creation process. And by this way, it is clear that several people together could create a lot

more than one single person. (Pulkkinen, 2006, p. 92)

This *vast and volunteered group of people* could be in the means of this thesis all the operational workers in each mill site. They could have a lot of useful information related to environmental or risk assessment matters from daily operations. If they would enhance their environmental knowledge, they could benefit their operational knowledge in environmental or risk assessment context, if they will have a proper forum to do that. And this would create more interaction and commitment to enhance the performance, for example, in better usage of resources.

One prevailing factor of organizational character is corporate culture. Culture varies a lot between mill sites, but a uniform managerial framework should be adapted in all sites. On the other hand, in some occasions might be challenging to fulfill these changes in management systems. Management practises in many mills have been formed during decades of forest industry, and it takes time to establish new ways of managing things. Besides, the management comfort should be considered, which in this case means the lack of synergy benefits. Collection and control of data have been done every site by their own data processing systems and practices for internal reporting. UPM is a big global company, which could use synergies of its versatile management systems. It has been noticed that major benefits could be within knowledge transfer and the use of the best practices in environmental management system development. In many mills, there are many good practises, which could be forwarded to other mills as well.

Relevant parts of the corporate culture are the values and attitude (Linnanen et al., 1997. p 176). These elements cannot be changed only by communication or education. Organizational culture modification process requires upgrade of the values, which should have to be built on existing value base step by step. The own values of management people strongly steers their behavior. So, if the corporation culture needs to be upgraded in some stages, for example in environmental issues, the process should be started from the top management team's environmental values. Top management team creates positive and active environmental values by their own actions, when they take part into the environmental management system steering group's conferences, for example. In addition, the top management

team should take the responsibility of the hazard or crisis, instead of blaming on the person, who has done the mistake (Linnanen et al., 1997, p 176). It might be relieving to say that this has been the direction in this Group at the moment. Environmental values have become as a one part of the Group management. And the actions after the incident in Kaukas mill is good example of this issue, described in Chapter 3.6.

2.2.4 Design of alliance and team work

Fourth part of *Main elements of learning through alliances* is managing collaboration and team work. The theoretical framework has been created to manage innovation strategies with joint venture companies in the first place. So in this thesis context, paper and pulp mill's interaction, the design of alliance is not that formal and bureaucratic, as it is in theoretical framework. The alliance is more likely interaction and team work within the company and between the mill sites and it shall be a great strength in the company's operations. Hence, the partner selection could be understood as partner in internal audits for mills, for example. Or on the other hand, partner could be understood in procedure in possible risk assessment system integration pilot project of two risk assessment systems. In this case the people related to this pilot project will be in close interaction with other and high level of trust, communication, objectives and rewards for the pilot project should be decided together.

2.2.5 Learning – the core element to develop the intellectual property

The most important outcome of *Main elements of learning through alliances* is learning. It is the diamond of the whole mind frame and the learning is the most important tool to decrease the obsolescence of company's operations. As it is stated in UPM, it is important to focus on continuous development and enhancements in environmental issues (UPM 2006b). It is inevitable to use as well as possible company's intellectual competences. To reach this demanding goal, three key elements of learning process have to be pointed out:

- intent to learn
- receptivity to knowledge

- transparency to partner and other mills

It is important to bring the practical management system solutions in the discussion in order to give the possibility to make changes where individual factories see it practical and where it could help them to solve their challenges. We also see that it is a must to UPM to respect the different cultures and ways to do things, as it is rather strength than a weakness to a global company like UPM. (UPM 2003, p.5)

One forcing power in continuous learning process is inevitably the will to do things. As Handolin and Saarinen (2006) discusses; for example Steers et al. (1996) begins from idea that work motivation is based on three parts: (1) What energizes people?, (2) What focuses peoples actions? and (3) What engages or boost existing energy level? Behind the performance is a humane motive, the world of will, choose, dream, believe and meaning. (Hämäläinen & Saarinen, 2006)

2.3 Summary of organizational learning process

To clarify this issue, the current environmental management has worked well in each UPM paper and pulp mill site. The issues, which have been established earlier in this chapter, have been moreover been a thinking framework; how to enhance the environmental management system in the future and how it would be more efficient as in general. The point is: *things have been done well, but we have to be prepared for the future challenges and use our resources as well as possible.* The sight has to be taken into the future critically, but still positively. Looking only into the rear mirror does not help anyone. In the long run, business has to be profitable and all "hindering" factors shall be minimized.

The company should sharpen the spirit and the state of mind, for the progress to happen in operational performance in the future. Anyhow, as a motivation milestone would be the local environmental authority's requirement to update the environmental risk assessment to each mill sites environmental permit, for example. Hence, it would be practical to make risk assessment as comparable as possible within Group level, and this is one of the main goals of risk assessment harmonization part in this thesis.

The summary is that the commitment to adapt continuous organizational learning among individuals, teams and organization, could result as seeing things from a more holistic and creative point of view.

3. MANAGERIAL APPROACH TO ASSESS ENVIRONMENTAL ISSUES

The links of managerial frameworks of this study are divided in these segments in this chapter:

1. Environmental strategy
2. Environmental management systems
3. Environmental management system planning and operational requirements
4. Good risk management - reference to investors
5. Risk assessment directions by authority
6. Environmental performance measurement

3.1 Environmental strategy of UPM

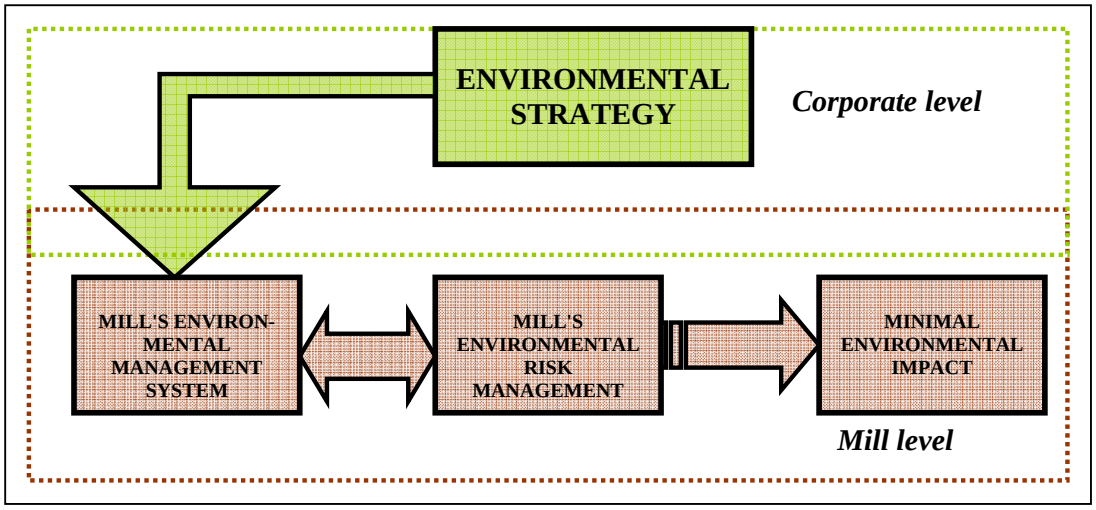

Figure 3.1 Linkage between environmental strategy and EMS

Figure 3.1 shows the environmental strategy link to the every mill's EMS and environmental risk management. Company has four strong principles in their environmental strategy for environmental management, which are (UPM, 2005b. p5):

- Common operations model in environmental matters to minimize business risks
- Certified ISO 14 001 environmental management systems in use in all production units

- Cooperation within divisions and functions and between them to share best practices and save costs
- Financial benefit of sound and transparent environmental behaviour and continuous improvement

One key element of company's environmental strategy is the environmental policy, which is described in UPM Code of Conduct. The Code forms the baseline for all company operations and sets out standards and guidelines of behaviour for each individual at UPM. The company is committed to implement best practices in the whole supply chain. Both, the direct and the indirect environmental loads and impacts of its operations are measured and assessed continuously and strives to manage these systematically in accordance with the principle of continuous improvement. The environmental loads and impacts related to product life cycle result from sourcing raw materials, production, distribution of products, and their recovery and disposal (UPM, 2006c).

3.1.1 Code of Conduct and paper divisions environmental rules

Company's EMS could be understood as a linking tool to implement the environmental strategy and the rules. And rules set the guidelines for company's actions. UPM paper divisions' environmental rules consist of seven focal areas (Pantsar-Kallio, 2006):

- Sustainable purchasing
- Energy efficiency
- Minimizing the environmental loads and impacts of production
- Quality of products
- Controlling the impacts of logistics
- Training and communication
- Organization for environmental matters

All the mills are promoting the use of wood from certified forests. This *"sustainable purchasing"* has strong correlation to the harmonized significant environmental aspect, *"raw material usage"*.

Second, UPM aims to reduce its impact on climate change in energy production, procurement and use. Energy audits are conducted regularly in all pulp and paper mills by UPM Energy division. This element has strong correlation to the identified harmonized significant environmental aspect "Energy usage", which has been established later.

Third, *"minimizing the impacts of pulp and paper mills"* can be achieved by reducing emissions to air and water, reducing production process water use and the total amount of process waste generated, as well as reducing the amount of waste to landfill. The environmental performance of the paper lines is benchmarked annually and compared to the performance levels defined in the European BAT reference. This parameter has strong correlation to identified environmental aspects, risk assessment and environmental indicators.

Fourth area is *"quality of the products"*. All UPM paper grades are recyclable and non-toxic to the environment or human health. There shall be no hazardous substances arising from minerals or other materials used, exceeding the established limit values.

Fifth area is *"controlling the impacts of logistics"*. The environmental impacts of logistics shall be controlled by careful planning of routes, optimizing the capacity utilization and encouraging the use of eco-efficient modes of transport. This has correlation to the harmonized significant environmental aspect, *"transportation"*, which in minority of the mill sites have not been identified as a significant environmental aspect.

UPM personnel are given both professional and general *"training"* in environmental matters. UPM's corporate values, which are openness, trust and initiative, are applied in external and internal *"communications"*. These last two elements have strong correlation and linkage to the chapter two *"management of learning and knowledge in environmental issues"*.

Final issue is *"organization for environmental matters"*. Environmental considerations can be an integral part of everyday operations in the mills, functions and sales companies. Environmental performance and continuous improvement are recognized as competitive factors and are key elements in the divisions' strategy, target setting and action plans. The mills shall implement the UPM environmental strategy by means of environmental man-

agement systems. Environmental target setting is done both at the mill, division and Group level. And these elements have strong correlation and linkage of the ideas established in chapter two *"management of learning and knowledge in environmental issues"*. (Pantsar-Kallio, 2006)

3.2 Environmental management

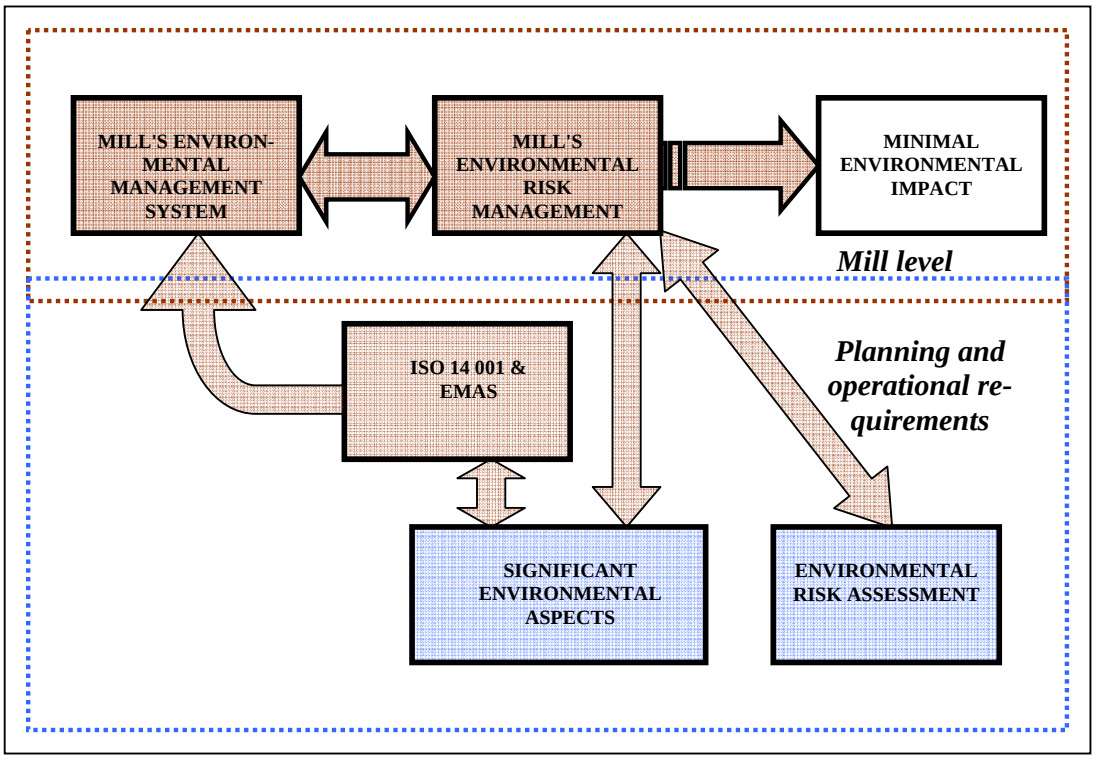

Figure 3.2 Linking the EMS with planning and operational requirements

Figure 3.2 presents the main idea of this chapter. It gives a clear idea of environmental management system and it presents the key elements of environmental management system; ISO 14 001 standard and EMAS scheme. Most of these issues are not new or unusual information, but it is crucial that everybody understands the top management decisions as those will be adapted to paper mills environmental management systems.

ISO 14 004 standard discusses (SFS-ISO 14 004, p.11) "An organization that has implemented an environmental management system can achieve significant competitive advan-

tages". That was the case 10 years ago in paper industry, but nowadays the situation is different. Certified environmental management system is rather the minimum criterion level in the whole company's management framework.

3.2.1 ISO 14001

It could be said that creating and administration of certified environmental management system would cultivate for organization towards more logical and systemic approach to improve their environmental performance. ISO 14001 certificate is not a new idea. Anyhow, it is important for each of the production units to upgrade and update their existing environmental management systems. On the one hand, ISO 14001 is a straightforward standard, but on the other hand the standard might be seen quite abstract. That is why the different production units have their own forms and opinions of their environmental management systems. That is considerable, because the practical issues vary a lot between different mill sites. This chapter points out some key issues from ISO 14001 standard.

ISO 14001 standard does not require straightforward demands on level of environmental protection or limit values. On the other hand, according to a standard, it has to match the level of legislation and other regulations and requirements by public legitimacy. In addition, the standard includes the requirements of the continuous improvement of the environmental protection. (Pesonen et al. 2005, p.15)

The main structure of ISO 14001 is divided into five parts (ISO 14001, 1996, p.14-21):

- Environmental policy
- Planning
- Implementation and operation
- Checking and corrective action
- Management review

Environmental policy in general is an engine of the management system. It is the trendsetter and besides with the whole ISO 14001, it is another important criterion against which the environmental management system could be assessed. (SFS – INFO, 1997. p.3)

Planning

Considering this thesis, the planning part of the ISO 14001 standard is the one of the most critical issues. The planning phase in standard definition begins with the identification all of the operations and products which could cause significant environmental affects. After that, the most feasible method to gather required information and the ways of action is discussed. The information is divided into the legislation and environmental protection requirements. When the operations and products which causes significant environmental affects, have been examined and identified, then there would be planned the aims of the development and precise targets for environmental issues of the company. The precise actions to fulfill and achieve these goals shall be established. (Pesonen et al., 2005. p.16)

Implementation and operation

Besides the planning, implementation is another key issue of this thesis. This part of the ISO 14 001 focuses on how the environmental management system is implemented in practice. The handling of the environmental issues is defined. In addition, the responsibilities and sharing the authorization and also about training of the employees and sharing of the environmental information is discussed. Besides, the documentation of the functions and storage of the documents is described. Which of these documents are linked up with the environmental management system, are given different instructions. In addition, the steering and the performance of the operations of significant environmental affects in normal conditions and in emergency situations are covered. (Pesonen et al., 2005. p.16)

Checking and corrective action

In this part, has been created the environmental management system and estimating the functions related on that system. In addition, the ways of acts in the situations when the system does not work as planned is discussed. To these deviation situations to plan the scenarios, how the system would work again, and how it could prevent or reduce the damage of the possible incident. The issue that how could company estimate their management system by themselves in internal audit regularly has been covered. In addition, what kind of background information of operations of this system will be needed for internal audit

would be discussed as well. (Pesonen et al., 2005. p.16)

Management review

Final part is regularly done management review of the environmental management system. Directors will certify with inspection that system is adequately efficient for managing the company's environmental effects and fulfilling legislative and ISO 14001 standard requirements. Purpose of this management review is to confirm continuous improvement in the company's environmental management system and the level of the environmental protection. (Pesonen et al., 2005. p.16-17)

3.2.2 EMAS

EMAS, the European Community Eco-Management and Audit Scheme, is a voluntary environmental management system for private companies and for public administration companies and organizations. EMAS is an environmental management tool for organization and it helps systemically to evaluate the environmental issues in all actions. It is based on EU's EMAS regulation (761/2001) and in Finland the Finnish EMAS law (914/2002). (Pesonen et al., 2005. p.16)

EMAS organization commits to three most important issues; including abiding the environmental legislation, continuous upgrading the level of environmental protection and public reporting on environmental issues (Suoheimo et al., 2006). According to EMAS, environmental management system has put into practise according to ISO 14001 standard. If company has already a certified system based on ISO 14001 standard, they have to write an additional public environmental report to receive an EMAS -registration for their system (Pesonen et al., 2005. p.16). Essential difference between EMAS regulation and ISO 14001 standard is how company is taking for granted the openness and obeying environmental legislations. EMAS requires always the public environmental report and gives guidance to do it. According to ISO 14001 standard, the public environmental report is voluntary. In addition, according to ISO 14001 standard, it is adequate that organization has action plans, how they will fulfill the legislation in certain amount of time. In addition, in EMAS regulation much attention has been paid to employees' participation and continu-

ous upgrading of the level of environmental protection. External evaluator verifies the functionality of system and confirms the information, which is established in report. This creates credibility for environmental actions in company. When EMAS organization does the registration, the company will be granted EMAS certificate and EMAS logo. (Suoheimo et al., 2006)

In Europe, it is recommended that organizations which have environmental management system certificate will operate with EMAS. Thus, it is recommended for UPM paper mills to have EMAS registration in European region.

3.3 Planning and operational requirements of EMS

The environmental management system planning and operational requirements are divided in to two parts:

- Significant environmental aspects
- Environmental risk assessment elements

First of all, what factors shall be measured and by whom, if we would like to discuss effectiveness of environmental management system in company? What benefits will we gain from such information? The main result of effective environmental management system shall utilize resources as effectively as possible, and the environmental impact or burden from company's operations would be minimal. Besides, cleaner environment could increase our welfare by environmentally sound operations.

In this chapter, these factors are divided into sub-chapters. First sub-chapter is about environmental aspects, which is one of the most important issues in discussion about environmental management system. When the significant environmental aspects have been identified, environmental risk management is closely linked to the goals and targets, which would be assessed after identification of significant environmental aspects.

3.3.1 Significant environmental aspects

The environmental aspects are defined in ISO 14004 standard as: "element of an organization's activities, products or services that can interact with the environment." In addition, there is stated – "A significant environmental aspect is an environmental aspect that has or can have a significant environmental impact." And environmental impact is defined as "any change to the environment, whether adverse or beneficial, wholly partially resulting from an organization's activities, products or services." (SFS ISO 14004. p.15)

The identified significant environmental aspects will give clear targets and goals to minimize environmental impacts and will clarify environmental management system of each mill. In chapter four, the current identified environmental aspects in UPM mills are presented.

If the environmental aspects and the significant ones are not definitely and clearly stated in each mill site, the whole clue of the environmental management system, according to the methodology described in the ISO 14001:1996, is lost (UPM, 2003. p11). That is why it is critical to clarify the common definition of significant environmental aspects for all production units. As the PWC research stated in chapter conclusions and recommendations, "The UPM-Kymmene methodologies for identifying and updating environmental aspects should be further studied and a common approach should be described (UPM, 2003. p.22)". According to Wessberg et al. (2006), in creating and maintaining an environmental management system, the essential task is to identify the environmental aspects. Based on identified significant environmental aspects, companies develop their environmental policies, which in UPM are a part of the Code of Conduct. Significant environmental aspects set the targets and goals, which are achieved by creating or updating environmental management system at corporate level. The main idea of the system at mill level is to identify environmental aspects from their operations and to create on their basis the targets and operations to minimize the environmental impacts.

Important question: is how indirect impacts, such as transportation, are taken as thoroughly granted within definition of significant environmental aspects among mill sites? ISO

14001 standard (4.3.1a) requires the valuation of impacts for company, "to identify the environmental aspects of its activities, products and services within the defined scope of the environmental management system that it can control and those that it can influence taking into account planned or new developments, or new or modified activities, products and services".

3.3.2 Elements of environmental risk assessment

The main purpose of environmental risk analysis is to identify hazards and the possibilities of interference emissions. Those are situations, conditions and structures which could result in an unexpected environmental impact. Environmental risk assessment analysis evaluates the environmental risk impacts caused by hazards. Therefore, the environmental risk assessment analysis should establish enhancement proposals to control the identified risks. According to this definition and comparing it to the definition of environmental aspects in ISO 14001 standard, environmental risk analysis is one part of implementation process of environmental aspects. Moreover, after identifying the environmental aspects, environmental risk analysis contributes ISO 14001 standard requirements in chapter *Emergency preparedness and response* (4.4.7). According to this chapter of a standard, organization has to create and maintain the identification procedures about possible accidents and hazards. In addition, they have to decide what actions should be taken into account in those situations, and how they would prevent and minimize the environmental impacts caused by accidents and hazards. (Wessberg et al., 2006)

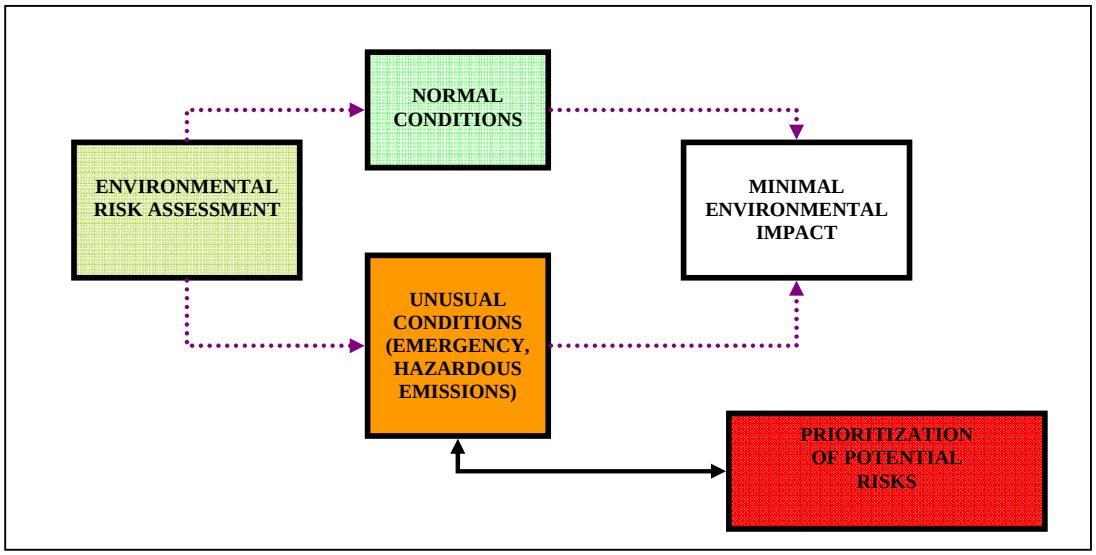

Figure 3.3 Environmental risk assessment

The environmental management of each mill site could be seen, from one point of view, as in an environmental risk assessment framework. The framework could be divided into two contexts in production units: daily emission control operations and unexpected operations and possible emergency situations, as shown in Figure 3.3. The daily operations have been operated well in many production sites. The greatest potential is to get prepared to unexpected conditions and situations by harmonized approach. Thus, the term mature state of environmental management system can be used to describe each production site's environmental management system. According to PWC final report, one recommendation in risk management was that the integrated risk assessment, which includes environmental, chemical, health and safety, quality, financial, etc., gives a way to handle environmental risks together with other assessed issues (UPM, 2003. p.22, 23).

Nowadays, also from authority's point of view, the everyday environmental impact from each paper or pulp mill is as minimal as possible (Silvo, 2006), and therefore the role of management of the hazardous emissions has been emphasized. In many cases, the hazardous emissions create the biggest amount of total emissions from the each production unit. The control of the hazardous emissions would prevent and minimize the environmental impacts. (Linnanen et al., 1997, p. 114) The greatest benefit could be succeeded by focus-

ing actions towards environmental risk assessment of hazardous emissions.

To be able to balance and point out the most relevant risks in corporate-wide terms, the crucial part is to find a uniform approach to valuate the risks within the company and to agree and define the scale for:

- Probability
- Consequence
- Risk classes

3.4 Good risk management - reference to investors

Risk management in general is an important part of organization's operations. In the first place, the incidents of the risks could be diminished significantly by identifying and controlling the possible risks and preventing acts can be established before any accidents. The continuity and stability of different processes can be guaranteed by getting prepared to the possible accidents and incident scenarios. In a big picture, the environmental risk management includes long and short-term emissions, and in addition the harmful changes in environment caused by accidents. Weighting of the environmental risks involves mostly the probability, magnitude and financial losses valuation and these actions would prevent these harmful changes to happen. (Ruohonen-Lehto et al., 2006)

The other dimension, instead of preventing risks taking place, would be the external investor's point of view and how they see the good risk management of a company as a strong contribution to the stability of the company. Typically, the investor often wants to know how risk management has been operated in the company. In cases where the environmental risk issues have been thoroughly taken into account, the smaller is the environmental and business risk. Consequently, the possible loss for investor is smaller. Anyhow, it is demanding to say, what investors' principal reasons for decision making are contributed to environmental risk management; whether to buy or sell company's shares in stock exchange. (Kuisma, 2001. p7) All in all, investors try to avoid any unnecessary risks. Companies with small risk levels have prevented the possible risks beforehand; have done the

environmental risk management better than competitors. It would be easy to understand and think about the amount of financial and non financial losses, as imago, by unexpected environmental risks, which would minimize the profits of investments. (Kuisma, 2001. p8)

3.5 Risk assessment directions by authority

Several Finnish institutes and interest groups have done a thorough research, YMPÄRI project. It discusses the risk assessment of the hazardous emissions in industry. The institutes were Finland's Environmental Administration SYKE, the Safety Technology Authority TUKES, and Technical Research Centre of Finland VTT. In addition, several interviews and workshops were arranged. Several authorities, consultants, certifiers of management systems and representatives of companies participated in discussion and all of them were obligated to have comments and opinions about the content of this project. Currently in Finland any formal instruction in risk management analysis method has not been established. So no guidance has not been established that how different units shall evaluate the environmental risks and what elements environmental risk analysis shall involve. The environmental risk analysis is a useful tool to guarantee the undisturbed operations of company and to become aware of the possible hazardous or interference emissions. (Wessberg et. al., 2006. p. 40)

The benefits of complying with the YMPÄRI project proposals are that operators are ensured that environmental risk analysis fulfils the requirements of environmental and chemical inspector authorities. In addition, it fulfils the requirements of certifiers of management systems. One example is the environmental risk assessment analysis, which is required by the environmental permit authority. This project proposal is based strongly on utilizing the risk analysis techniques in formal risk identification framework. Clear instruction and tools for evaluating the probability and magnitude of risks have been given by environmental risk magnitude matrix and valuation matrix. (Wessberg et. al., 2006. p. 40)

The YMPÄRI project proposal has given a recommendation for the content of the environmental risk management scope, shown in Figure 3.4. In that case, the environmental risk analysis includes the five core elements:

1) Definition of the target
2) Identification of the risks
3) The magnitude evaluation and the probability and consequences of the risks
4) Significance evaluation of the risks
5) Proposals for acts

Figure 3.4 points out the most important part in this thesis, the evaluation of the risks and the definitions which are related to it. These most relevant elements have the darkest colors in Figure 3.4. The definition of the target and identification of the risks are important issues as well. Considering the scope of the thesis, the discussion should be structured as compact as possible in evaluation and definition of the risk assessment parameters. The significance of the risks means the balancing of the risks to the local conditions and situations; as social and financial aspects. The significance evaluation could be considered tightly as acceptability evaluation of the risks, established in Figure 3.5. It establishes the matrix of valuating the consequences and probabilities of the risks. In this context, it is important to discuss how these parameters, consequences and probabilities are defined. YMPÄRI proposal is an approach in estimating the possible risks, but it is not the only form. Generally, the structure of the YMPÄRI proposal is compact and comprehensive.

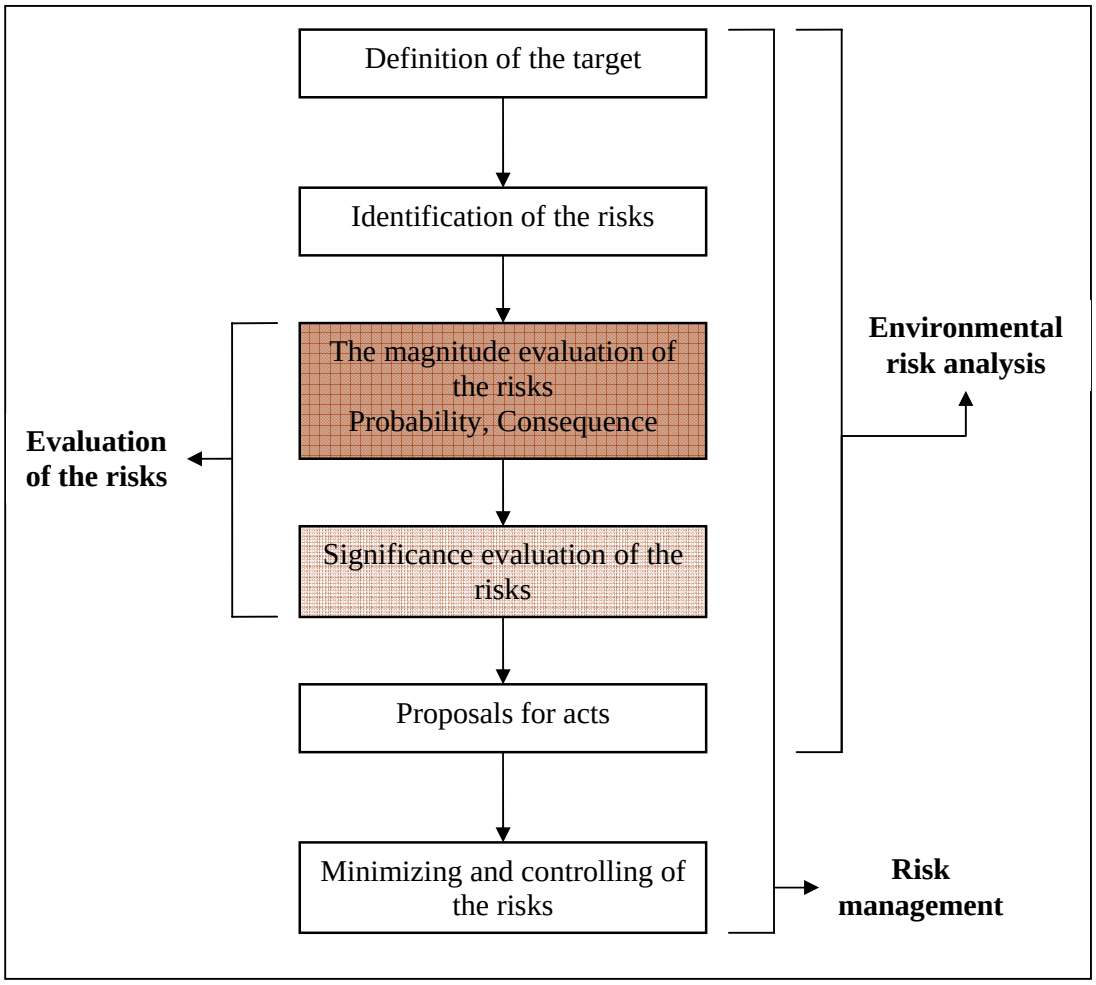

Figure 3.4YMPÄRI proposal (Wessberg et al., 2006. Figure 3)

The evaluation of significant risks and classification of urgency of risk management acts, are defined in different risk classes. Those could be described based on magnitude, probability and consequences according to evaluation matrix in Figure 3.5. The risk classes established here are indicative and risk classes have to be described as case specifically. (Wessberg et al., 2006. p. 35)

The matrix in Figure 3.5 has been upgraded after this draft version during the upgrade process (Wessberg & Molarius, 2006). In newer version, it has fourth consequence level. But the number of risk classes has not been changed. These probability levels have been defined after many practical experiments. Scaling levels seems to be useful. But this

YMPÄRI proposal is a one approved approaches from authority not the only possible solution to assess risks. (Wessberg, 2007)

PROBABILITY		**RISK CLASS**		
More than once in a month and/or risk management has been described as weak	5	II	I	I
More than once in a year and/or risk management has been described as fair	4	II	I	I
More than once in a 10 years and/or risk management has been described as fair	3	III	II	I
Once in a life cycle of plant and/or risk management has been described as good	2	IV	III	II
Situation known in industry (occasionally has happened somewhere) and/or risk management has been described as excellent	1	IV	IV	IV
		1	2	3
CONSEQUENSE		**MINOR**	**GREAT**	**SERIOUS**

Risk Class I	Eliminate the risks immediately.
Risk Class II	Manage the risks within a few months.
Risk Class III	Manage the risks within one or two years.
Risk Class IV	Manage the risks, when there would be the suitable opportunity.

Figure 3.5 YMPÄRI proposal of risks evaluation matrix (Wessberg et al., 2006)

3.6 Environmental performance measurement

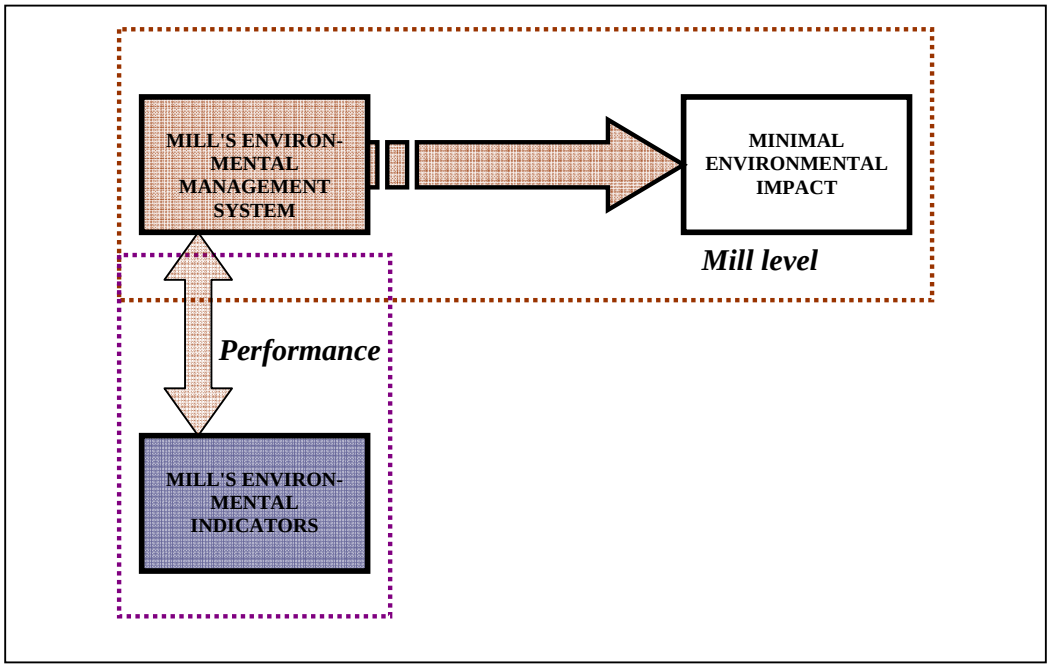

Figure 3.6 Environmental performance link to EMS

This chapter discusses the environmental indicator information and what issues it comprises. Indicators implement and prove the effectiveness of environmental management system of each site from operations implementation point of view. The indicator information is reported mainly to external interest groups, and these indicators emphasize the level of the environmental performance of the company in each production unit as Figure 3.6 illustrates.

Global company has global challenges. Most multinational companies have established worldwide standards for environmental performance, creating benefits and bringing challenges. New facilities abroad are constructed with latest environmental technologies and processes designed to minimize waste, but older facilities often still have negative environmental impacts. Reducing those impacts and complying with various local and national regulations create challenges in organization and coordination. (Epstein, J, Marc. 1996 p. 61)

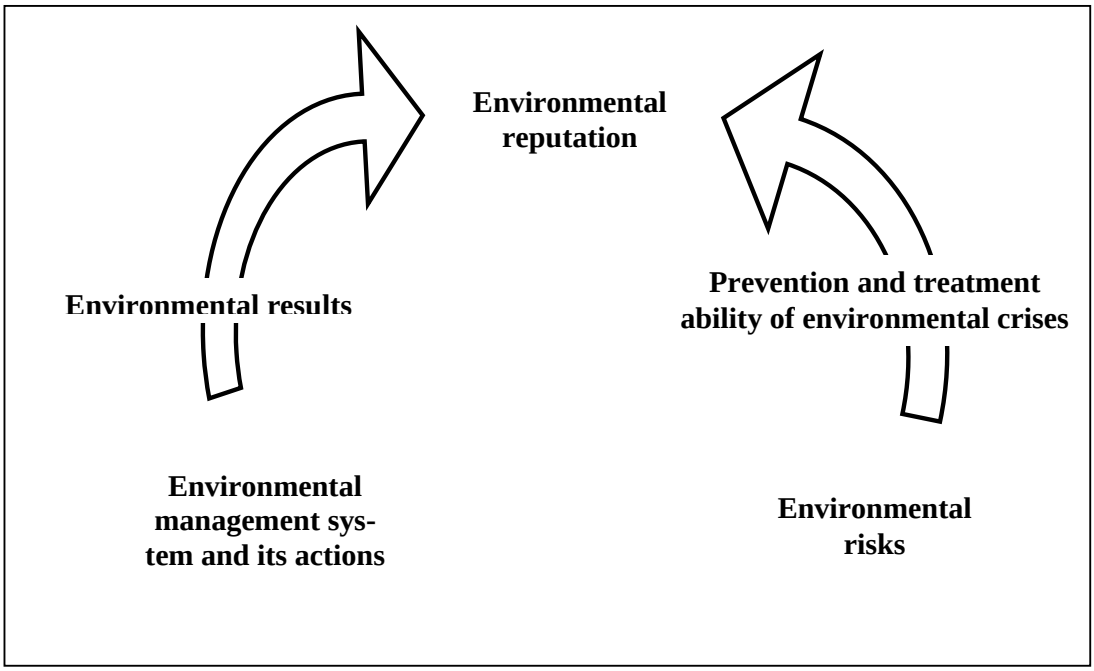

Figure 3.7 Formation of the environmental reputation (Linnanen et al., 1997. p.152)

Figure 3.7 establishes the importance of environmental reputation as a relevant part of the company's image in terms of environmental performance. The framework includes two elements: the environmental results and the prevention and treatment ability of environmental risks. In the long run, it is important to convince the investors that company manages the environmental performance as carefully as possible. Besides, harmonization of environmental management system and risk assessment elements could have strong correlation in environmental reputation by its actions in the long run, with uniform targets and uniform risk assessment methods. In general, environmental reporting of the company itself is functional tool in creating a good environmental reputation and liability. The company proves the commitment on environmental issues and possibly it could participate to the public environmental discussion by publishing environmental information (Sjöblom & Niskala, 1999. p.33). In this context, it may be assumed that environmental results could be understood as environmental performance indicators of each production unit. In addition, to build a credible environmental reputation, it is required to communicate as realistically and also involve risk assessment as one way of communication of the company. The risk communication and company's environmental acts create trust and therefore potential envi-

ronmental crisis will not destroy the image of the company. (Linnanen et al., 1997, p151)

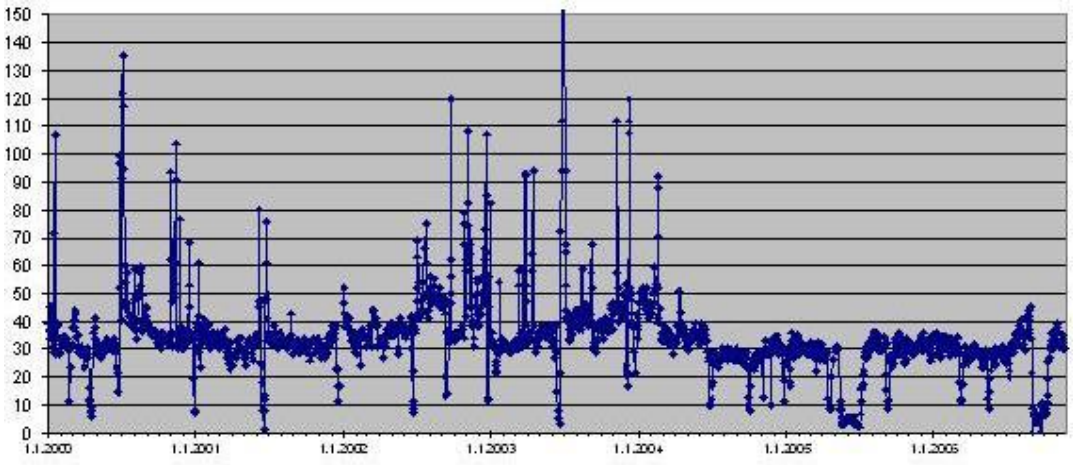

Figure 3.8 COD levels in Kaukas mill after sewage treatment plant

Figure 3.8 establishes Kaukas Chemical Oxygen Demand (COD) levels after and before summer 2003 hazard and impacts to the lake Saimaa. The benefits of learning process are tremendous, when unite goals have been defined in mill's top management. The mill management decided that actions have to be taken in better control, not to exceed in limit values of COD and improve the effluent treatment plant's performance. Investment costs were 5m€ and the actions were (Simpura, 2007):

- Separate flow channels to effluent in paper mill
- Better sludge collection before treatment plant
- Power enhancement in aeration of effluent treatment plant
- Better measurement

The limit value for COD discharge after effluent treatment plant has been set to 65 (t/d) by authority. Y -axis in Figure 3.8 shows COD concentration (t/d) and x -axis is the time dimension. This shows the results of integrated decision making and it has strong correlation to environmental performance level, measured in this case by COD.

4. HARMONIZATION OF THE SIGNIFICANT ENVIRONMENTAL ASPECTS

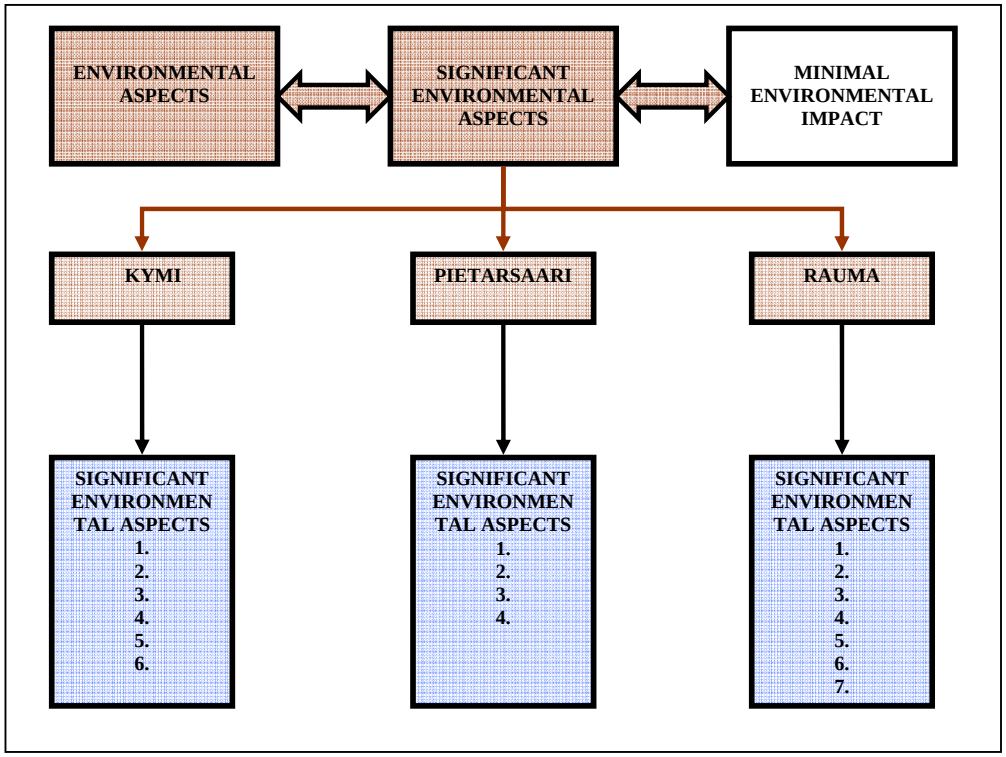

Figure 4.1 Linking the framework of environmental aspects

This chapter analyzes three examples of paper and pulp mills and their identified parameters of significant environmental aspects. The result from examination of these examples is the main focus of this thesis; the harmonization process of these elements. Key points in this chapter are:

- Establish all production sites' significant environmental aspects within Group
- How to define effectively significant environmental aspects - method by example
- Proposal for harmonized significant environmental aspects

4.1 Identification of environmental aspects

4.1.1 Significant environmental aspects in UPM paper and pulp mills

An important question could be assessed: why significant environmental aspects are so different between each site and can they be harmonized? It is important to clarify how significant environmental aspects have been defined and weighted in each production unit. In UPM mills, the definition is not uniform: the outcome of significant environmental aspects varies a lot. According to Wessberg & Molarius (2006) and Silvo (2006), there is no formal definition method given from authority in EU. Every site has a great deal of environmental aspects and each site has to make their own decisions how to valuate the significant environmental aspects from not that significant ones. We have to remember that each production site has their own micro environment with certain details and special characteristics. On the other hand, the industrial processes are more or less the same in different mill sites. I assume that the variation of the definition method results most variation and uncertainty to the defined significant environmental aspects in mill sites. We can agree the limit number of identified significant environmental aspects, namely five to seven.

In Table 4.1 is shown all UPM mill sites significant environmental aspects examined in PWC research (UPM, 2003). As can be seen, aspects vary a lot between paper and pulp mills. As discussed before, the most applicable uniform parameters shall be examined, that all mill sites could approve.

Mill	Significant Environmental Aspects											
	Water use	Water effl.	Energy	Air emissions	Waste	Transport	Chemic handl.	Odour	Noise	Resources	Permits	Else
Augsburg	1	1	1	1	1			1	1	1		
Blandin			1				3			1		
Caledonian		2			1						1	
Changshu	1	1	1	1	1			1	1	1		2
Chapelle				1	1		4					
Jämsänkoski	1	1	1		1				1	1	1	
Kaipola	1	1	1		1				1	1	1	
Kajaani	1	1	1		1				1	1	1	
Kaukas		1	1	2	1	1			1	1		
Kymi		1	1	1	1	1				1		
Loparex		1	1		1					1		
Miramichi		1		1	1		1			1		1
Nordland	1	1	1	1	1	1		1	1	1		
Pietarsaari		1		1					1	1		
Rauma	1	1	1		1				1	1	1	
Schongau	1	1	1	1	1	1		1	1	1		
Schwedt	1	1	1	1	1	1		1	1	1		
Shotton	1		1	1	1			1	1			1
Steyermühl	1	1	1	1	1	1			1	1		
Stracel	1	1	1		1			1	1			
Tervasaari	1	1	1		1			1	1	1	1	
Voikkaa		1	1	1	1	1			1	1		
Mills of 22	13	19	18	13	20	7	3	8	16	18	6	3

Table 4.1 Significant environmental aspects of UPM mills

This study analyses more precisely three different mill sites, Kymi, Pietarsaari and Rauma significant environmental aspects. All three mills are pulp and paper integrates, so they have roughly similar production facilities, with certain exceptions. To be precise, the pulp is bought to Rauma paper mill from Metsä-Botnia pulp mill, which is located close to paper mill. Therefore it is not pulp and paper integrate and the environmental aspects are valuated to paper mill only. The studied mills are located in Finland as it was thought to be more comprehensive to start the analysis from a small pilot exercise to maintain the scope and possibly effective results.

4.2 Examples in definition of significant environmental aspects

Table 4.2 shows the identified significant environmental aspects in three selected mill sites. Diversity of these parameters is relatively wide-ranging. Even certain similarities between the parameters can be found. The point of view and definition framework makes differences to the results in identified significant environmental aspect. It is important to define a method to allocate a wide variety of environmental aspect parameters to significant environmental aspects. These significant ones cover all the environmental aspects from mill sites in a compact form.

Mill	Kymi	Pietarsaari	Rauma
Identified significant environmental aspects			1. Amount of process water
	2. Raw material usage	2. Wood procurement activities (UPM Forest)	2. Raw materials usage
	3. Energy usage		3. Energy usage
	4. Effluents to water	4. Fractions of waste waters effecting Pietarsaari sea areas	4. Waste water load
	5. Emissions to the air	5. Air polluting substances to Pietarsaari district	
	6. Waste		6. Waste (utilization)
	7. Transportation		7. Permits
		8. Noise (env. & health and safety)	8. Noise

Table 4.2 Significant environmental aspects of three exampled mill sites

4.2.1 Kymi

Kymi has used the Life Cycle Analysis (LCA) master's thesis as identification method of significant environmental aspects (Møller Christensen, 1994). The method is consistent, thorough and detailed and it clearly points out, which were the identified aspects. Besides, environmental aspects have been defined by using the valuations scale from 1-250. This number value has been called the significance index and these valuated parameters have been linked to estimated environmental impacts and have been defined, under which significant environmental aspects it is belonging to. The identified parameters are linked to environmental risk assessment analysis and the connection between each risk assessment parameters and significant aspect is clearly available. For example, transportation in Table 4.1 has been identified in only six other mills than Kymi and none of these were either Pietarsaari or Rauma. In Kymi LCA analysis, transportation was one of the most significant environmental aspects by affecting a great deal of total environmental impact from operation. Thus, transportation should be among the harmonized significant environmental aspects. Table 4.3 shows the main titles of environmental aspect parameters assessed in Kymi system. Appendix 1, Appendix 2 and Appendix 3 presents the screen shots of defined environmental aspect.

If a method to define the significant aspects has to be chosen, I recommend Kymi's approach as a reference to other mill sites.

Therefore, Pietarsaari and Rauma mill's, significant environmental aspects are benchmarked towards Kymi's ones. And the contribution is given between them.

Address field	
Source	
Aspect and impact	
Significance of environmental impact	Probability Magnitude for total discharge Scale of impact Image factor
Significance index	max. 250
Linkage to significant environmental aspects	

Table 4.3 Main titles of environmental aspects significance index valuation in Kymi

4.2.2 Pietarsaari

The environmental aspects and their impacts in Pietarsaari mill's operations have been valuated and registered by collecting the information from processes and operation control, from literature, from own and other mills researches, authority demands and communication with interest groups. (Saari, 2007)

Since all possible environmental impacts cannot be fixed or eliminated, must be examined the environmental impacts, which are the most significant for environment and manufacturing the products themselves. The significant environmental aspects in Pietarsaari mill have been defined as an outcome of a long process by weighting these parameters. However, the method is quite flexible and any formal analysis method has not been used. Anyhow, these environmental aspects have been discussed annually. Table 4.2 establishes these defined aspects. Pietarsaari mill site is located on the shoreline of the Baltic Sea and thus the majority of the possible environmental impacts focus on to the break water of Baltic Sea.

To analyze Pietarsaari significant environmental aspects, they can be compared to Kymi's ones. As Table 4.2 shows, the second parameter of Pietarsaari *"wood procurement activities"*, could be defined as Kymi's *"raw material usage"*. Fourth parameter *"fractions of waste water effecting Pietarsaari sea areas"*, could be defined *"effluents to water"*. Fifth parameter, *"air polluting substances to Pietarsaari district"*, could be defined *"emissions to the air"*. Seventh parameter *"noise"* could be acceptable, if they identify it as a significant environmental aspect. The mill is close to the city center and many people are living close to the mill. There is no indication about process water usage, solid waste and transportation among significant environmental aspects. Process water is defined as important element in Pietarsaari management system handbook, as a part of the environmental impacts, and it could be defined under *"raw material"* parameter. Currently, the process water parameter has not been defined as a significant environmental aspect, as in inbound resource. The outbound discharge, as in waste water form, is only examined.

4.2.3 Rauma

UPM Rauma paper mill buys pulp primarily from Metsä-Botnia pulp mill, which is located close to paper mill. As a characteristic in Rauma paper mill, it is located on the shoreline of the Baltic Sea and therefore many environmental impacts focus on the break water of Baltic Sea as in the case in Pietarsaari.

Rauma paper mill's environmental aspects and significant one's identification is based on researches of environmental conditions, regulations of authorities, environmental risk assessments and attentions of interest groups and workers. All this vast information is structured with common sense and significant environmental aspects have been defined. (Vatka, 2007)

Environmental performance has improved during past few years. For example, one indication is the reduced amount of water usage and the amount of eutrophication has been reduced during past few years. The risk management has been improved by prioritizing the most significant issues and preventing acts have been identified. (Vatka, 2007)

Likewise in Pietarsaari, Rauma has not any formal method to define their significant envi-

ronmental aspects and the method is quite flexible, but still useful. The parameter in Table 4.2 *"amount of process water"* in Rauma's significant environmental aspects could be defined under *"raw materials usage"*. The reason why Rauma has own parameter for process water usage is that they have small resources for water. Their seventh parameter *"permits"* would not be granted as a significant environmental aspect. It is an obligatory element of mill's environmental management system, not the significant environmental aspect. In addition, *"noise"* could be accepted as a significant aspect, if they have identified it as a significant element. They are located, as Pietarsaari, close to inhabitants; so the possible noises of operations in factory could be conceivable. Consequently, significant environmental aspects' including these changes, fits well to the harmonization scope.

4.3 Proposal for harmonized significant environmental aspects

Table 4.2 establishes the different examples of defined aspects. The basic structure is consistent in all analyzed examples. But the uniform approach has to be agreed among all production sites. As analyzed above, the Kymi's assessment system has been thoroughly structured and it sets comprehensive approach. Rauma's and Pietarsaari's significant aspects were roughly similar to Kymi's significant aspects, with certain exceptions. Some changes need to be taken and then all of the production sites would have the uniform significant aspects. Table 4.4 establishes that Rauma and Pietarsaari could consider would this be a useful approach as significant environmental aspects, including *"transportation"*. Besides, *"noise"* parameter could be suitable for Rauma and Pietarsaari. As discussed earlier, the *"transportation"* parameter was not included in Rauma's and Pietarsaari's significant aspect. In Kymi's LCA -analysis, however it was one of the most important environmental aspects and as a proposal of this work should be included significant aspects to other mills also. *"Noise"* is optional parameter for mill sites.

Mill	Kymi	Pietarsaari	Rauma
Identified significant environmental aspects	Raw material usage		
	Energy usage		
	Effluents to water		
	Emissions to the air		
	Waste		
	Transportation		
	Noise		

Table 4.4 Proposal for harmonized significant environmental aspects

5. ENVIRONMENTAL RISK ASSESSMENT ANALYSIS PROCEDURE

This chapter describes the environmental risk assessment processes and differences of each application by three analyzed examples. Key points in this chapter are:

- Different elements in identification of environmental risk assessment
- How to define environmental risk assessment parameters?
- Proposal for harmonized risk assessment parameters
    1. Probability - scaling
    2. Environmental impact definitions – scaling
    3. Risk classification – amount of levels

5.1 Examples of risk assessment system frameworks

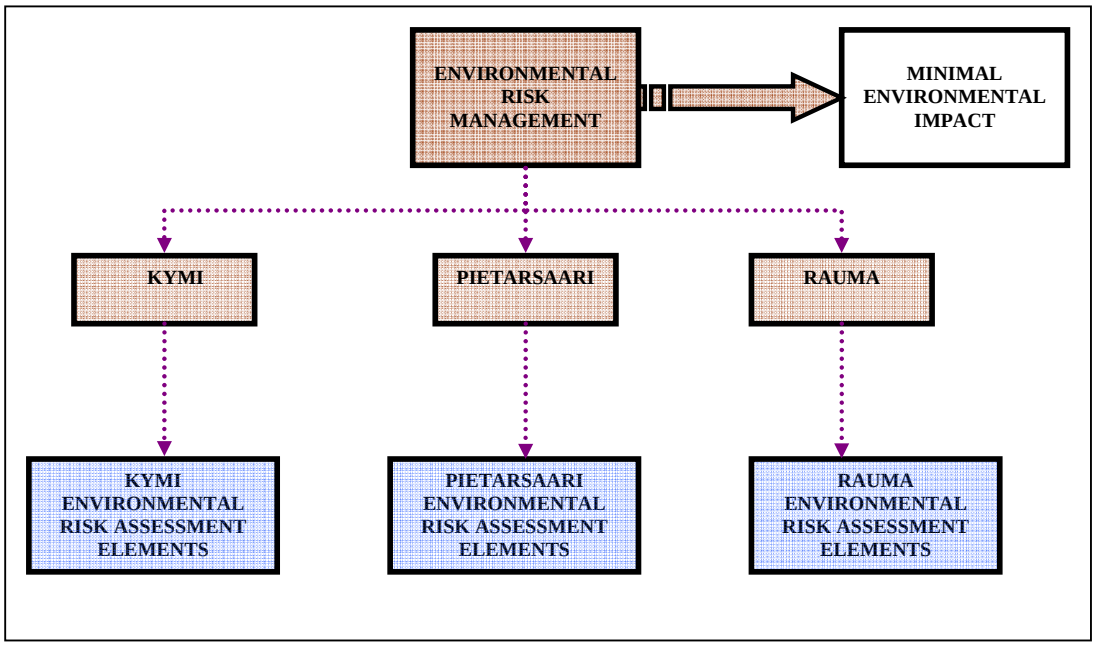

Figure 5.1 Environmental risk assessment systems

5.2 Risk assessment analysis examples

5.2.1 Kymi

Kymi's environmental risk assessment system includes both environmental and chemical elements of risk assessment. It is an effective way in evaluating possible risks. The probabilities of environmental and chemical risks scales are in Table 5.1. The impacts of environmental risks scales are shown in Table 5.2 and Table 5.3, the valuation of chemical danger of defined risks.

Environmental and chemical risks probability		
0	Not possible	
1	Very unlike	Less than once in 10 years
2	Unlike	Less than once in a year
3	Possible	Annually
4	Probable	Monthly
5	Very probable	weekly or continuous

Table 5.1 Environmental and chemical risks probability valuation in Kymi system

Environmental impacts		
0	Negligible	
1	Relatively minor	Impact on a leak place or internal limit value exceeding
2	Minor	Impact on mill area, more load to effluent treatment plant or notice to authority
3	Moderate	Slight impact on environment, problems in treatment plant or exceeding in limit values
4	Remarkable	Impact on effluent treatment plant or detected environmental impacts
5	Serious	Serious impact on environment or interruption of operations in effluent treatment plant

Table 5.2 Environmental impacts valuation in Kymi system

Chemical danger		
0	Negligible	
1	Relatively minor	Temporary injury of one person
2	Minor	Temporary injury on several people
3	Moderate	Permanent injury on one person
4	Remarkable	Permanent injury on several people
5	Serious	Death of one or several people

Table 5.3 Chemical danger valuation in Kymi system

Table 5.4 establishes the environmental and chemical danger index. The index has been calculated as a product of probability and impacts. For example, number 8 in Table 5.4 could be the result of product of serious impact (4) and unlike probability (2).

Significance / **Probability**	1. Minor	2. Significant	3. Very significant	4. Serious	5. Very serious
1. Very unlike	1	2	3	4	5
2. Unlike	2	4	6	8	10
3. Possible	3	6	9	12	15
4. Probable	4	8	12	16	20
5. Very probable	5	10	15	20	25

Table 5.4 Risk magnitude valuation in Kymi system

And these calculated index values in Table 5.4 have been divided in seven risk classes. Table 5.5 establishes the defined risk classes. The risk classes have not been numbered in their system, but for clarity reasons and for future benefits, they have been given numbers. These classes have contribution to chemical substance classification. For example, the substance which has highest chemical risk has been classified as number one. In addition, YMPÄRI proposal has the same approach.

Risk classes	
Class 7	Insignificant (1)
Class 6	Minor (2)
Class 5	Tolerable (3,4)
Class 4	Moderate (5,6,8)
Class 3	Remarkable (9,10,12)
Class 2	Very remarkable (15,16)
Class 1	Intolerable (20,25)

Table 5.5 Definition of risk classes in Kymi mill site

5.2.2 Rauma and Pietarsaari

The environmental risks have been valuated in both Rauma and Pietarsaari mill site in a same scale 1 – 5. The scales have been used in definition of probability, personal injuries, damage to property or financial impacts (€) and environmental impacts. Table 5.6, Table 5.7, Table 5.8 and Table 5.9 establishes the risk definition scales.

Probability		
1	Very unlikely	less than once in 30 years
2	Unlikely	once in 10 – 30 years
3	Slightly probable	once in 5-10 years
4	Fairly probable	once in 2 – 5 years
5	Very probable	more than once in 2 years

Table 5.6 Probability valuation in Rauma and Pietarsaari systems

Personal injuries	
1	Minor accident (less than 1 week sick leave)
2	Serious accident (1-8 weeks sick leave)
3	Serious invalidity
4	One people dead, many in danger
5	Several people dead

Table 5.7 Personal injury valuation in Rauma and Pietarsaari systems

Damage to property or losses after interruption in process (€)	
1	3000 – 30 000
2	30 000 – 150 000
3	150 000 – 1 000 000
4	1 000 000 – 5 000 000
5	more than 5 000 000

Table 5.8 Financial impact valuation in Rauma and Pietarsaari systems

Environmental damage		
1	Relatively minor	Damage in a leak place
2	Minor	Mild peak to effluent treatment plant
3	Moderate	Peak in emissions to sea and/or remarkable destruction in micro-biological population
4	Remarkable	Exceeding of the limit values or fish and eco population deaths
5	Serious	Serious damage to the sea

Table 5.9 Environmental damage valuation in Rauma and Pietarsaari systems

Likewise in Kymi's system, Table 5.10 establishes the environmental risk impact values. The values have been calculated as a product of probability and impacts.

Probability	Impacts/Consequences				
	Relatively minor	Minor	Moderate	Remarkable	Serious
Very unlike	1	2	3	4	5
Unlike	2	4	6	8	10
Slightly probable	3	6	9	12	15
Fairly probable	4	8	12	16	20
Very probable	5	10	15	20	25

Table 5.10 Risk magnitude valuation in Rauma and Pietarsaari systems

And these calculated values in Table 5.10 have been divided into nine risk classes. Table 5.11 establishes the defined risk classes. The risk classes have not been numbered in their systems, but for clarity reasons and for future benefits, they have been given numbers. As a reminder, likewise in Kymi's risk class definition, the classification numbering is based on chemical risk assessment for different substances and the same approach was in YMPÄRI proposal.

Risk classes	
Class 9	Insignificant risk (1)
Class 8	Very minor risk (2)
Class 7	Minor risk (3,4)
Class 6	Moderate risk (4,6)
Class 5	Remarkable risk (5,8,9)
Class 4	Acute risk (10,12)
Class 3	Very acute risk (15,16)
Class 2	Serious risk (20)
Class 1	Intolerable risk (25)

Table 5.11 Definition of risk classes in Rauma and Pietarsaari mill sites

5.3 Analysis of probability scaling

This chapter establishes the uniform environmental risk assessment probability parameter's proposal. It is obvious that this proposal would open the discussion for uniform methods to assess risks in mill sites, based on the available information and examination analysis. This chapter examines only probability scaling, because the other analyzed elements did not have significant differences. Base for proposed parameters, excluding probability, did exist without additional analysis.

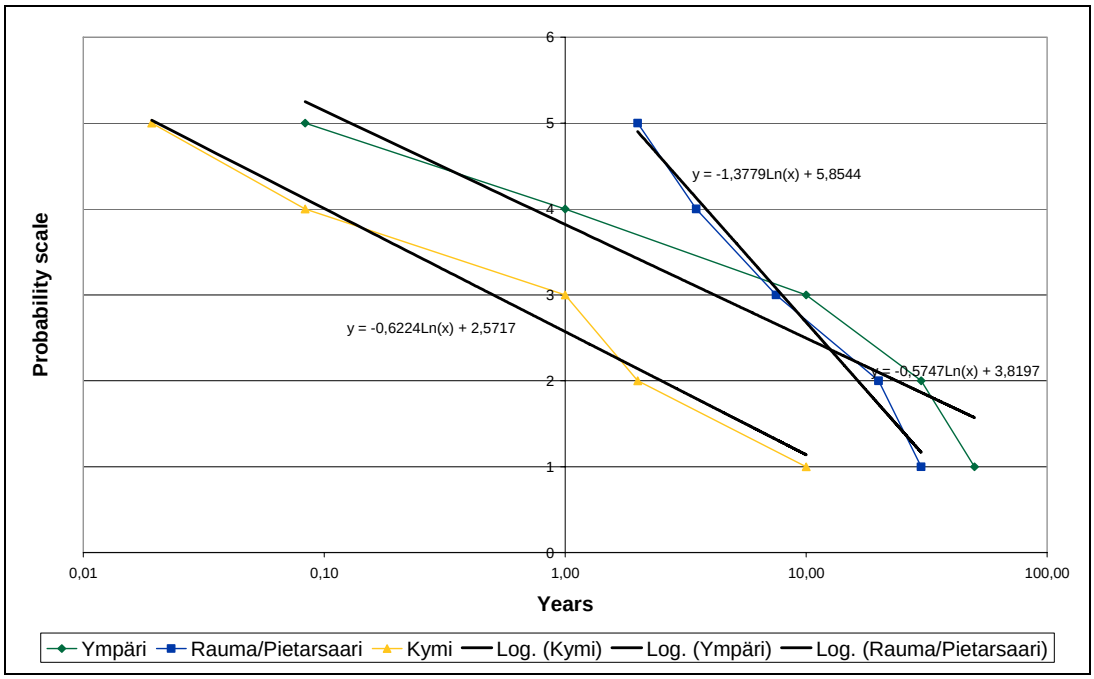

Figure 5.2 Difference of risk probability scales between mill sites

Figure 5.2 establishes the examined risk assessment probability valuation scales in three mill sites and in YMPÄRI project proposal. Y -axis establishes the probability scale from one to five and x -axis establishes the estimated risk probability frequency in a logarithmic scale. The logarithmic scale is more informational than linear scale by establishing the whole time frame range; from one week to several years, in more detailed form in a same figure.

The most important calculated factors in Figure 5.2 are:

- slope coefficients of three graphs
- intersectional points of three graphs
- brief analysis of the information

The graphs in Figure 5.2 have been analyzed by adjusting the regression analysis of the data in sum of least squares method. The slope coefficients are similar in Kymi and in YMPÄRI proposal, -0,6. In Pietarsaari and Rauma the analyzed coefficient factors were -1,4. The intersectional points are in Kymi's graph +2,6, in YMPÄRI proposal's graph +3,8 and in Pietarsaari's and Rauma's graph +5,9. As a reminder, the y -axis scale was from one to five. This component reflects that the intersectional point in Rauma and Pietarsaari system is not as optimal as possible; if we assume that graph in Rauma and Pietarsaari scale does not intercept the y -axis in defined scale, where the axis was located in 1 year dimension. Therefore, the Kymi's +2,6 intersectional point establish the most suitable way the time frame from week level to many years.

Kymi's scale is the most useful, because it is relatively widely ranged and its scaling is similar to YMPÄRI proposal. In the lower end of x -axis, it establishes more steps for frequent and continuous risks. Where in Pietarsaari and Rauma graph can not reach under two years time frame in valuation. On the other hand, YMPÄRI project proposal have two steps less than one year while Kymi has three steps. The intersectional point in each graph establishes this issue. In addition, the examined data was not totally comparable, because of definition problems of probability levels descriptions. Therefore, for example YMPÄRI proposal has literal descriptions for levels four and five, instead of numeric. Kymi's level two do not have specific description. How to define *less than one year*? In this case, it was estimated as half a year. And in Rauma and Pietarsaari graph the data points have been calculated based on the averages of described levels. For example, level two, "once in 10 – 30 years", has been calculated as 20.

Consequently, if the deviation emission information in each mill site would be in more effective and practical use, it would gain additional value to assess risks more frequently and

also would have useful utilizing method to upgrade risk assessment system by practical information of mill's processes. Information for probability analysis in risk assessment would therefore have stronger correlation to practical unexpected conditions. In this context, Kymi's probability valuation has more potential to these purposes as well, because the probability scale reaches to week time scale. At the moment, for environmental deviation reports have been stored in two different databases:

- Environmental reporting database
- Each mill sites database with different utilization rate

First, environmental reporting database is for serious situations purposes. Those could be exceeding of limit value and which may cause significant environmental impact. Whereas each mill sites database deviation report is for smaller errors in mill's operational processes. Therefore, both systems have their own approaches, but the most important thing is the activity of using either systems. For example, Table 5.12 shows the reporting activity in Kymi database. Consequently, the management people have emphasized the importance of making such reports from any errors in processes (Jussila, 2007). And the results have been positive. On the other hand, the deviation reporting activity in pulp production unit has been relatively weak and their activity used to be stronger than in paper production unit a few years ago. This is a good example of the importance of encouraging employees' commitment of their work and could be succeeded by education, learning, implementation and guidance.

	2006	**2005**
Paper	68	44
Pulp	10	6
tot.	78	50

Table 5.12 Kymi database minor deviation reporting activity

5.4 Harmonized environmental risk assessment proposal elements

Table 5.13, Table 5.14 and Table 5.15 show the proposal of the harmonized environmental risk assessment parameters. The proposal focuses only on environmental risk assessment elements, because only those were in the scope of this thesis. It is important that these risk assessment systems include other elements as well, for example chemical risk assessment.

Environmental risks probability		
0	Not possible	
1	Very unlikely	Less than once in 10 years
2	Unlikely	Less than once in a year
3	Possible	Annually
4	Probable	Monthly
5	Very probable	weekly or continuous

Table 5.13 Proposal for harmonized probability parameters

The probability assessment scale has been analyzed earlier in this chapter. As Figure 5.2 shows, the Kymi's probability valuation was the most useful. So the Table 5.13 establishes the proposal of probability valuation parameters.

Environmental impacts		
0	Negligible	
1	Relatively minor	Impact on a leak place or internal limit value exceeding
2	Minor	Impact on mill area, more load to effluent treatment plant or notice to authority
3	Moderate	Slight impact on environment, problems in treatment plant or exceeding in limit values
4	Remarkable	Impact on effluent treatment plant or detected environmental impacts
5	Serious	Serious impact on environment or interruption of operations in effluent treatment plant

Table 5.14 Proposal for harmonized environmental impact parameters

The proposed approach, which Table 5.14 establishes, has more or less the same elements as it has been approved in examined mill sites. So this does not have any significant changes in the prevailing risk assessment systems.

Risk classes	
Class 7	Insignificant (1)
Class 6	Minor (2)
Class 5	Tolerable (3,4)
Class 4	Moderate (5,6,8)
Class 3	Remarkable (9,10,12)
Class 2	Very remarkable (15,16)
Class 1	Intolerable (20,25)

Table 5.15 Proposal for harmonized risk classification parameters

As it has been discussed earlier in this chapter, the number of risk classes varies between examined mill sites. The YMPÄRI proposal has four risk classes and Kymi has seven risk classes. Besides, Pietarsaari and Rauma have defined nine risk classes. Consequently, YMPÄRI proposal could experience changes in the future, as one more consequence level. So the amount of risk classes in their approach would not decrease, moreover those could increase. In addition, the seven risk classes are roughly from the middle from the four and nine range. So, seven risk classes would be sensible approach as a harmonized parameter and it is shown in Table 5.15. Table 5.3 shows the balance of the defined risk classes as the numbers in parentheses as the Table 5.15 indicates. On the other hand, the balance of the risks is not that strict, since risks have to be valuated individually and it may have its certain characters. But the balance of the environmental risks in this proposal is informal and sets the outlining of the risk assessment criterion. For example, the chemical, financial or image risks could have different balancing approach and this issue would need extra examination. Anyhow, the most important issue in risk assessment is the prioritization of possible risks and to preventing possible situations beforehand, despite the chosen approach of the risk assessment system within mill sites.

6. CASE STUDY OF INTEGRATED RISK ASSESSMENT SYSTEM IN RAUMA EFFLUENT TREATMENT PLANT

This case study analyzes the challenges of integrating these two different systems with their own characteristics and the result would be the proposal for integrated risk assessment system. The idea in the nutshell is the integration process of environmental risk assessment parameters with health and safety assessment parameters in Rauma mill's effluent treatment plant. The target is to harmonize two separate risk assessment systems by using uniform software. This is a pilot case study for the whole Group' purposes. If this study shows positive results, the framework could be applied in other mill sites in future. This is the tip of the iceberg in the whole scope of this thesis.

6.1 Background to the study

6.1.1 Starting point and target of the study

This case study examines the Rauma mill site updating procedure of the current risk assessment system: to combine two different risk assessment systems; environmental and health and safety systems. Currently, from environmental manager point of view in each mill site, it is relatively complicated to use both systems simultaneously as efficiently as possible. It is not efficient to use most of the time to search right information from several places. In that sense, the integrated risk assessment system would be practical for environmental managers for example, and for their every day purposes. And if they have to analyze the possible risks, the environmental manager does not think just about the possible environmental, H&S, chemical or other relevant impact of possible risks. They would rather think the total outcome of the possible risks and try to prevent them to happen. It would be practical if the data would be available from the same interface.

6.1.2 Resources and possible challenges

Despite the known potential of the integration of the systems, many mill sites struggle with limited resources. The detailed analysis of different systems integration needs knowledge, time, people and money. This case study sets the first screening steps and outlines the chal-

lenges of combining two individual systems.

These two different risk assessment systems have significantly different characteristics as themselves. First of all, they have several fundamental differences. These differences are not obstacles for integration process. They only set the greater challenges for the process. The data exists in both systems. The environmental risk assessment system has been developed by consultant Esko Rossi. The application of the system has been done with Microsoft Excel. The risks have been allocated in 29 parameters. The health and safety system has been done into Lotus Notes software, "Turvallisuustoiminta" - application. And the risks have been allocated in 20 parameters. This application has been approved in all Finnish paper and pulp mills. Many people are familiar with using this application. The current application will be upgraded soon. Therefore, it would be efficient to screen the possible integration options of current application version before the upcoming upgraded version would be released.

Referring to the learning process in the second chapter, it is necessary to establish the motives for team work. The long historical background of different production units decelerates setting the uniform targets in many issues, including this case study. System's integration potential is known in many forms, but the major actions towards it could be done better. The organization has too many imaginary fences and decision making could be better. In this sense, it could be useful to create better team work among the organization across the business units and use the synergy benefits. This case study points out the practical step one of such process.

6.1.3 Threshold questions

First of all, we have to assess relatively fundamental and important questions to succeed in integration process between two risk assessment elements:

- How these risk assessment systems differ from each other?
- What are the risk assessment parameters definitions?
- What are the most significant challenges integrating these elements?
- Are there any limitations to upgrade the "Turvallisuustoiminta" software?

- Do these two systems have any uniform parameters or other factors in first stage of process?

6.1.4 Actions to proceed in integration

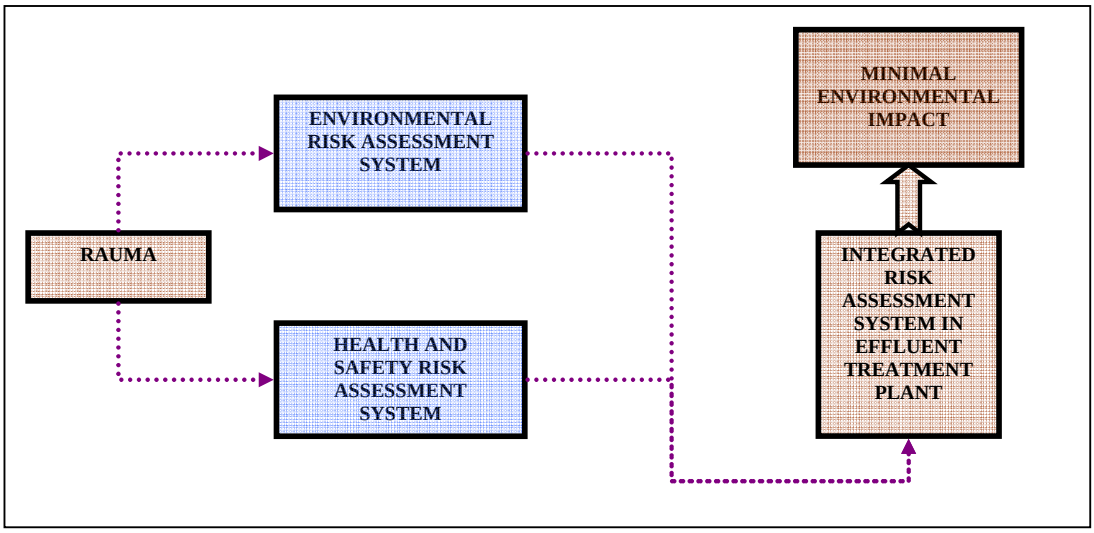

Figure 6.1 Case study framework in Rauma effluent treatment plant

Figure 6.1 establishes the common intellectual framework of this case study. It sets the goal for this case study. Environmental and H&S assessment systems have been developed in different time frames and for different purposes. But nowadays the point of view has been accepted that these systems could be more efficient when they are integrated. On the other hand, the integration is still not always the automatic path to the glory. Certain challenges have to be faced and overcome.

One uniform risk assessment method is the magnitude matrix. The magnitude includes two elements, the probability and the impacts of the risks. Table 6.1 has the combined information of last chapter tables, Table 5.10 and Table 5.11. Table 6.1 establishes environmental risk classes and Table 6.2 establishes the H&S risk classes. Those are divided by different colours. Hence, the main principles of these magnitude valuation matrices, Table 6.1 and Table 6.2, have basically the same idea. Both approaches are appropriate and effective. This case study examines the integration process of these two different systems. Therefore, there has to be either a decision to have an ultimate goal for common approaches for both

systems or an approach to assess risks by any other sensible way.

Probability	Impacts/Consequences				
	Relatively minor	Minor	Moderate	Remarkable	Serious
Very unlike	1 (Insignifi-cant risk)	2 (Very minor risk)	3 (Minor risk)	4 (Moderate risk)	5 (Remarkable risk)
Unlike	2 (Very mi-nor risk)	4 (Minor risk)	6 (Moderate risk)	8 (Remarkable risk)	10 (Acute risk)
Slightly probable	3 (Minor risk)	6 (Moderate risk)	9 (Remarkable risk)	12 (Acute risk)	15 (Very acute risk)
Fairly probable	4 (Moderate risk)	8 (Remarkable risk)	12 (Acute risk)	16 (Very acute risk)	20 (Serious risk)
Very probable	5 (Remark-able risk)	10 (Acute risk)	15 (Very acute risk)	20 (Serious risk)	25 (Intolerable risk)

Table 6.1 Risk magnitude valuation in Environmental assessment system

Probability	Seriousness of impacts		
	Minor	Harmful	Serious
Unlike	1. Insignificant risk	2. Minor risk	3. Moderate risk
Possible	2. Minor risk	3. Moderate risk	4. Significant risk
Probable	3. Moderate risk	4. Significant risk	5. Intolerable

Table 6.2 Risk magnitude framework in health and safety system

The most significant differences between the Table 6.1 and Table 6.2 are:

- the size of the magnitude matrix

=> different amount of risk levels

- different definitions of the parameters

To order to integrate environmental and H&S risk assessment systems, it is important to first define these parameters and decide the matrix used. The decision maker should prioritize the most significant risks from integrated system and by this mean the different risk

assessment systems could be more alive and more practical in every day operations.

From the practical point of view, certain fundamental challenges have to be faced. First, the environmental risk assessment system is more industrial process oriented, whereas the health and safety risk assessment system analyzes the possible risk impacts on one or several people. For example, there are two examples, environmental risk assessment parameter *"primary settling tank"* and the H&S risk assessment parameter *"handrails of effluent treatment plant's primary settling tank do not exist"*. The possible problems in effluent treatment *"plant primary settling tank"* could cause impacts on surrounding environment by exceeding discharge. Whereas, *"the handrails of effluent treatment plant primary settling tank do not exist"* could cause an impact of some person's possible falling and drowning. The importance of both point of views are equally significant, but this fundamental starting point results two different risk assessment approaches.

As a brief starting point conclusion, two optional paths are possible for the process in this case study:

1. Decide what the definitions for the parameters are and what risk assessment valuation matrixes are in both systems. This would be more or less the sketch of the project, if the software can not be used. In other words, to gather information and do nothing practical.
2. Both risk assessment systems would have their own parameter definitions and the risk assessment matrixes in step one. The proposed H&S software would include the environmental risks assessment parameters. This would be the practical pilot case study and would have practical results.

The second option seems better, because it would be flexible and it would have the effectiveness by practical experience. As discussed before, several fundamental differences could result in significant challenges to make relatively big changes in both systems. And both systems work well currently. So in common sense, it would not be sensible to make too significant changes in functional systems in the first step. Anyhow, the final goal of the project would be the uniform system, but during these first steps, the second proposal op-

tion above, would be an opening for wider discussion. In the beginning of this chapter has been discussed about few questions. The last question was: *"Are there any uniform parameters or other factors in process first stage?"* The uniform parameters do not exist, because of the fundamental differences of two different systems.

The common function in both systems, examining about the Rauma effluent treatment plant, would be the position number. In this case, the position number would be effluent treatment plant, 08060. For other examples purposes, the uniform function would be for example the position number for paper machine 4, PK4 02042 in Rauma mill site. This would be the most efficient approach to allocate the risk assessment parameters from both systems.

6.2 Proposal for integrated risk assessment analysis

In Rauma effluent treatment plant 20 different health and safety risk parameters have been assessed, in which 18 parameters have been assessed in shift four and 2 parameters in shift five. Besides, 28 different environmental risk parameters have been assessed in their own analysis. As discussed before, these parameters have been defined by a different approach. That causes the result:

Only relevant uniform element, among the two separate systems, is the effluent treatment plant in general.

Appendix 4 establishes the selected example of interface of health and safety system risk assessment parameter. The defined risk is *"the handrails of effluent treatment plant primary settling tank do not exist"* and its impact would be *"falling and drowning"*. The risk has been assessed by using magnitude analysis in Table 6.2. Table 6.3 establishes the H&S part of integrated risk assessment system. The risk classification for this parameter is 1, Insignificant risk. The first column and second row "*Health/Safety*" in Table 6.3 establishes that discussion of the defined risk parameter assesses the H&S risk and the definition matrix has the dimension 3*3. The matrix is based on authority's requirements for industrial safety distict.

Position number	**08060 Effluent treatment plant**			
Health/Safety	***Environmental***	***Chemical***	***Imago***	***Financial***
	Seriousness of impacts			
Probability	Minor	Harmful	Serious	
Unlikely	1. Insignificant risk	2. Minor risk	3. Moderate risk	
Possible	2. Minor risk	3. Moderate risk	4. Significant risk	
Probable	3. Moderate risk	4. Significant risk	5. Intolerable	

Table 6.3 The interface of application in heath and safety risk assessment

The risk assessment parameter in environmental risk assessment system has been assessed by using magnitude analysis in Table 6.1. Table 6.4 establishes the environmental part of integrated risk assessment system. The second column and second row "*Environmental*" in Table 6.4 establishes the interface of the defined risk parameter. It assesses the environmental risk and the definition matrix has the dimension of 5*5.

Position number	**08060 Effluent treatment plant**				
Health/Safety	***Environmental***	***Chemical***	***Imago***	***Financial***	
	Impacts/Consequences				
Probability	Relatively minor	Minor	Moderate	Remarkable	Serious
Very unlikely	1 (Insignificant risk)	2 (Very minor risk)	3 (Minor risk)	4 (Moderate risk)	5 (Remarkable risk)
Unlikely	2 (Very minor risk)	4 (Minor risk)	6 (Moderate risk)	8 (Remarkable risk)	10 (Acute risk)
Slightly probable	3 (Minor risk)	6 (Moderate risk)	9 (Remarkable risk)	12 (Acute risk)	15 (Very acute risk)
Fairly probable	4 (Moderate risk)	8 (Remarkable risk)	12 (Acute risk)	16 (Very acute risk)	20 (Serious risk)
Very probable	5 (Remarkable risk)	10 (Acute risk)	15 (Very acute risk)	20 (Serious risk)	25 (Intolerable risk)

Table 6.4 The interface of application in environmental risk assessment

As Table 6.4 establishes other interfaces, chemical, image and financial risk assessment parameters are optional for the future applications. This proposal integrates only two elements, environment and H&S risk assessment.

6.3 Summary of the case study

The most convenient option would have been the option number two from *"two optional paths"* – to make a practical pilot project by using "Turvallisuustoiminta" software. But at the moment it was not possible. Main reason why it was not accomplished was that only two persons could do any coding for that software, and they were fully employed. And probably people could not see the as much potential for integration process as the hypothesis was. So the only possible solution was the option number one: *"Decide what the definitions for the parameters are and what risk assessment valuation matrixes are in both systems."* In other words, the result was gathering and screening of information from both systems. Nevertheless, the total outcome of the case study was not as effective as possible. However, this case study gives useful starting point for possible risk assessment system updating process in the future.

This case study was a good example about current situation, based on the learning potential, which was outlined in chapter two. The starting point, for example in this integration case was clear, but the implementation for pilot project was missing. Idea, which was established in Figure 2.3 *Main elements of learning through alliances* and every step of it, has a clear correlation to this case study. Or more or less, why this idea framework should be discussed and adapted more clearly as a part of organizational learning.

7. SUMMARY

This thesis is a narrow part of the Group's EMS process in UPM. This thesis examines the harmonization research problem to set the common elements for significant environmental aspects and environmental risk assessment methods. It is essential to understand what steps should be taken in the near future within this process. At the moment, mills perform relatively well in environmental issues, but things could always be done better. From managerial point of view, the greatest potential in environmental performance enhancement would be succeeded by prioritization the most serious risks. It is important to understand that intent to learn new things would be one cornerstone to see the available paths and probably gain the organization's performance by utilizing better the intellectual property. In that sense, the key thing is adaptive organizational learning and individual learning processes. On the other hand, the learning process may result in better environmental performance by enhancing for example the ecological efficiency in paper and pulp production.

This thesis outlines the harmonized elements; significant environmental aspects and environmental risk assessment. The decision to implement these elements has to be done to obtain the uniform goals and targets. The first step towards integrated risk assessment in the Group would be launched by harmonization of these elements. Integrated risk assessment system would make the system more alive and more useful to assess and analyze risks. Examined case study outlines the challenges of integrating two separate elements; environmental and H&S risk assessment. In this study, the practical elements were lacking, but for future development, it has set the starting point.

8. PROPOSAL FOR FURTHER RESEARCH

First, the risk assessment system framework has been examined in the scope of environmental risk assessment harmonization and the case study examined the integration of two different risk assessment systems. So, the first screening results have been examined and further study in wider approach of integration of several other risk assessment elements would be the next step.

Second, for gaining benefit from organizational learning, the further studies aspect approaches vary a lot. For example, the network analysis has not been studied as a structure of a management tool. This has strong correlation to work psychology and the research would have sufficient elements to dissertation. From environmental issues point of view research problem would be; how could environmental knowledge be transferred to operational level as effectively as possible by identifying the points of discontinuity in corporation's employee's network. Would major results happen if the education, learning and know-how would be transferred to those people who work related to the paper manufacturing processes for example? How would environmental manager gain benefit, if they would understand the network of people who they are working with and where to put forward most education. If they would know the right links to deliver the information and it could affect on right persons behaviors? Are those most important persons the production managers of certain paper machine line, for example?

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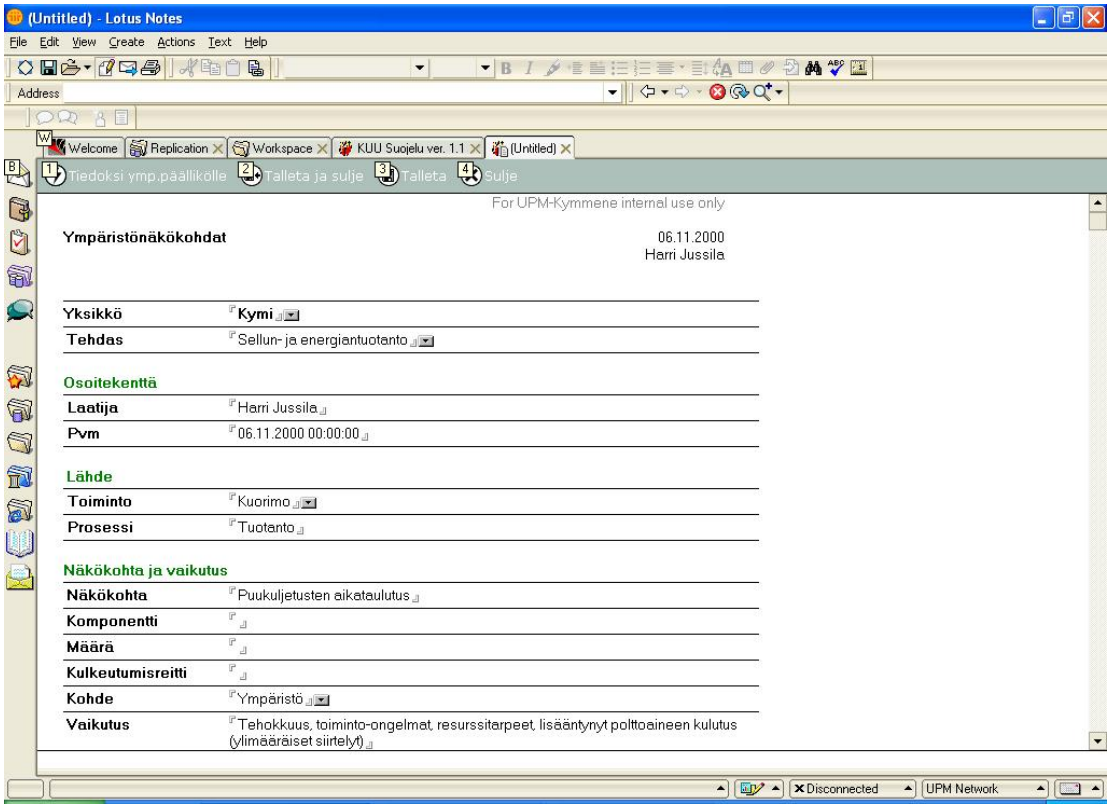
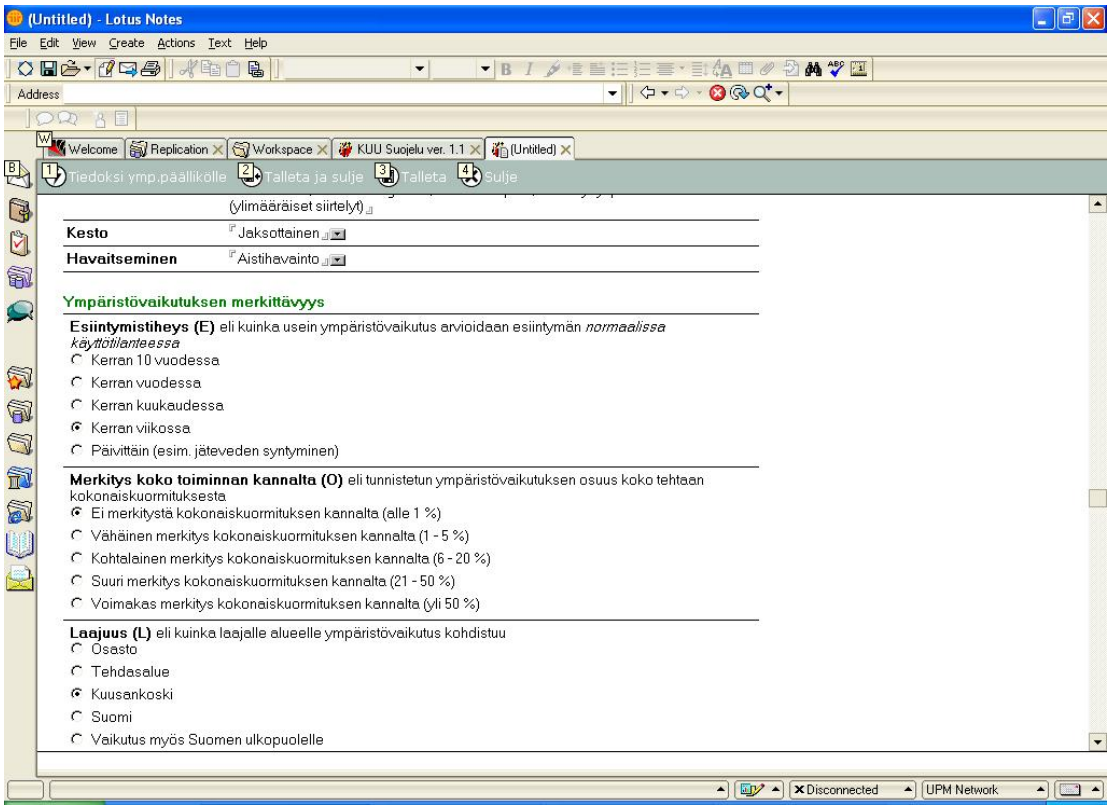
APPENDICES

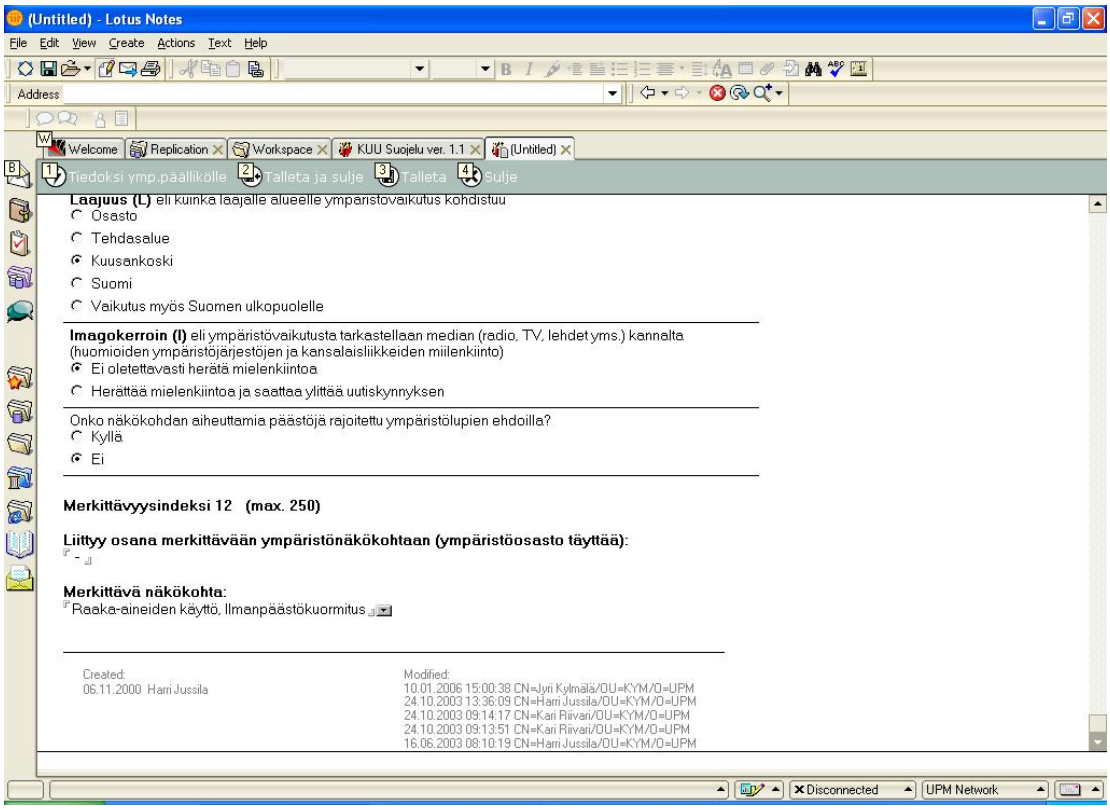
Appendix 1 Part 1 of Kymi Paper definition of environmental aspects significance index



Appendix 2 Part 2 of Kymi Paper definition of environmental aspects significance index



Appendix 3 Part 3 of Kymi Paper definition of environmental aspects significance index



Appendix 4 Health and safety risk assessment example of one parameter