IMPLEMENTATION OF AN INTEGRATED ENVIRONMENTAL MANAGEMENT SYSTEM IN A LATVIAN CONSTRUCTION COMPANY

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IMPLEMENTATION OF AN INTEGRATED ENVIRONMENTAL MANAGEMENT SYSTEM IN A LATVIAN CONSTRUCTION COMPANY

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ABSTRACT

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This thesis essayed to find an approach to environmental aspect and indicator identification in order to establish a valid base for implementation of an integrated environmental management system in a Latvian construction company. The construction industry has been selected as the area of interest because its “product” is affecting humans, the environment and other industries in the most direct and significant way. A management system is required for achieving a balance between development driving forces. By examining existing environmental management systems - their weaknesses and strengths - opportunities for improvement were determined and used during development of the approach. The thesis includes a review of legislation, international standards, and research. The result of the thesis is a 2-Level Matrix, which serves as an environmental aspect identification and relevant indicator selection tool. Within the theoretical framework, the established approach was tested at construction sites and discussed amongst construction experts. The matrix allows performance of environmental aspect ranking and provides support for the decision-making process, while establishing an Integrated Environmental Management System.

CONTENTS

1 INTRODUCTION

In the global agenda, sustainability and environmental protection issues are increasingly at stake. Discussions on the construction industry and its contribution to sustainable development have resulted in important political statements, e.g. the European Union “Green Paper” and the “European Strategy for Sustainable, Competitive, and Secure Energy: A policy framework to strengthen EU manufacturing – towards a more integrated approach for the industrial policy”. The fundamental premise is that the environment of the future will need to be constructed and operated in ways consistent with the principles of sustainability. Beside concerns about the use of resources and protection of the natural environment, sustainable development requires social and financial balance. A management system is required for achieving a balance between development driving forces. From the vast variety of developed management systems, the developed purpose of the Environmental Management Systems primarily is environmental protection. As a basis for this particular thesis, perspectives of an Environmental Management System have been used.

The contribution to sustainability of the currently available Environmental Management Systems is questioned. There are doubts, whether the current Environmental Management Systems ensure better environmental, economic, and overall performance (Cerin, 2005). Lack of demand for clearly defined objectives and targets does not encourage the management to establish a rigorous environmental baseline (Ghisellini, 2005).

Therefore, the research problem of the Thesis is defined as establishment of an Integrated Environment Management System in the Construction branch. The research question focus is on suggestions for an environmental management strategy, which would prevent conceptual imperfections of the currently available environmental aspect and indicator identification approach of the Environmental Management Systems. The objective is to seek a method for environmental aspect and relevant indicators identification approach, which would strengthen the credibility of the Environmental Management System and eliminate conceptual imperfections,

which influence the systems’ sustainability. The established method shall be in a position for assimilation into the Total Management System.

The thesis is divided into two stages: the first – clarification and evaluation of the established systems for environmental management; the second – a statement of the company’s current situation, using the developed method and interrelation to construction industry policy. In the first stage, a review of the legislation, standards, and literature has been performed. The legislation and standards provide a framework, which is necessary for establishment of a valid and legal Environmental Management System. The literature review provides an overview of other research and findings on relevant issues.

During the second stage of the Thesis work, the obtained information regarding Environmental Management Systems was applied in establishing a method for aspect identification. The Expert Method was used for understanding the company’s current situation process baseline. The acquired information was supplemented with site inspection data.

The strategic sustainable development model of Robe`rt and Schmidt-Bleek (2002), was used as the general research basis. The Strategic sustainable development decision-making model is “a planning approach that relies on continual consideration of the broader system in which specific actions are embedded” (Robe`rt and Schmidt-Bleek, 2002). The Strategic sustainable development model delineates interrelatedness between hierarchically different system-levels. The model distinguishes interrelatedness between existing tools and concepts. The conceptual understanding about available tools and systems prevents making dead-end decisions.

The thesis structure is as fallows:

Chapter 2 outlines the aim and objectives of the Thesis.

Chapter 3 describes the situational settings of the problem. It describes why the thesis object is Latvian construction industry and particularly a company. It gives a short introduction to the situation regarding Management Systems of the leading companies in the Latvian construction market.

Chapter 4 describes the methods used during the process of writing the thesis that can be classified in three groups. The first – the review of

legislation and available standards, such as ISO 14001 and EMAS. The second group of methods is the review of specialized literature. The expert method and site inspections are classified in the third group.

Chapter 5 consists of several sections that firstly describe ISO, EMAS and in-house Environment Management Systems in general. In the first section, a critique on broadly used Environment Management Systems is summarized and suggestions on how to eliminate those weaknesses are provided. In the second section, the importance of recognizing critical environmental effects and activities, and available methods for identification of such environmental aspects and impacts are described. An overview of approaches for evaluation of aspects’ significance and indicator selection is included in Chapter 5 as well. Sources of information were specialized literature. Based on the approach described above, a method for Environmental Management System aspect and indicator identification has been developed and suggestions to an improved Integrated Environmental Management System have been made.

In Chapter 6, there is a discussion on whether the aim of the Thesis has been reached and what the practical use of the research could be. Issues, which could be further elaborated and developed, are described in this chapter as well. In Chapter 7, the most important conclusions of the Thesis are presented.

2 AIM AND OBJECTIVES

The aim of the Thesis is to establish a conceptual approach to environmental aspect and indicator identification and make strategic suggestions for implementation of an integrated Environmental Management System in a Latvian construction company.

The aim can be reached by having a method for the environmental aspect and indicator identification, which is made on a base of literature reviews and site inspections. The suggestions for the strategy of an environmental management system should be based on global and long-term development trends. Therefore, the objectives of the Thesis are to:

1. Clarify whether the most frequently used Environmental Management Systems are sustainable and do improve companies’ environmental performance;
2. Clarify the existing situation with respect to implementation of Environmental Management Systems in the Latvian construction branch;
3. Identify possibilities for EMS improvements;
4. Determine global and long-term development plans and relevant legislative acts, which will frame the activities of the construction industry;
5. Give practical suggestions for improvement of environmental aspect and impact identification and Environmental Management strategy development.

3 SITUATIONAL SETTING OF THE PROBLEM

In our time, when all imaginable information is available in enormous quantities and “sustainability” becomes an excellent trademark, it is important to evaluate and look for justification of the chosen development pathway. Therefore, this particular Thesis seeks to look for an approach to an environmental management system that is based on sustainability principles and can be integrated into the Total Management System.

The construction industry has been selected as the area of interest because its “product” is affecting humans, the environment, and other industries in the most direct and significant way.

The Thesis was written considering the construction industry from a Latvian and European Union perspective, because currently the construction industry in Latvia is experiencing a transition from an underdeveloped and poorly managed activity to a growing and dominating industry. It is interesting to observe how the market is changing by influence of Latvia being a part of the European Union and by growing demands of both social and environmental awareness.

The current situation in the Latvian construction market can be described as rapidly growing. It can be seen in *Dienas Bizness* (Business newspaper) and *Lursoft IT* aggregated information (Latvijas lielākie uzņēmumi Top 500, Dienas Bizness in cooperation with Lursoft IT; 2005) about the largest construction companies and their economic indicators. The biggest construction companies are ranked according to the net turnover in year 2004. The results for 30 companies were published.

In order to obtain information on whether the biggest construction companies have acquired a management system certification, a simple inquiry was made. Information about ISO/ OHSAS certification for listed companies was as follows (Table 1):

1) Out of the 30 largest construction companies, 7 enterprises had certified themselves according to ISO 9001:2000; ISO 14001:1996; OHSAS 18001:1999; four companies had according to ISO 9001:2000; ISO 14001:1996 or ISO 9001:2000; OHSAS 18001:1999; four companies had certified themselves only to ISO;

2) Out of the 30 largest construction companies, 7 enterprises were operating in the real estate market. Three real estate developers were certified according to ISO 9001:2000; ISO 14001:1996; OHSAS 18001:1999; two real estate developers have performed ISO 9001:2000; ISO 14001:1996, and one company has performed ISO 9001:2000; OHSAS 18001:1999 certification. Two companies have not performed any certification.

Table 1. Summary of the situation for Latvian construction companies with respect to ISO/ OHSAS certification.

	ISO 9001:2000	**ISO 14001:1996**	**OHSAS 18001:1999**	**Total**
Construction companies (out of 30)				**15**
	☑	☑	☑	7
	☑	☑		2
	☑		☑	2
	☑			4
Real estate developers (out of 7)				**6**
	☑	☑	☑	3
	☑	☑		2
	☑		☑	1

The real estate companies were of particular interest in this study and have therefore been specifically characterized in Table 1.

The studied companies can be divided into two major groups according to their business strategy; in the first group are those companies, which have own construction equipment and personnel. In the second group, are companies providing only construction management services.

For both groups the reasons to proceed with ISO/ OHSAS were similar. In order to participate in the State and municipal tenders, companies are required to have ISO/ OHSAS. On a large scale, the construction objects involve several sub-contractors and suppliers. In order to ensure and guarantee quality, ISO was preferred by the construction enterprises.

Until the year 2000, there was no marked demand for ISO or similar certification. Most of the above mentioned construction companies have obtained their ISO and OHAS certificates in year 2004.

Important reasons for writing the Thesis focusing on construction companies as a platform for change were:

- The intention to find an approach to environmental aspect and indicator identification suitable for practical work;
- The possibility to test the approach in practice and thus get a chance to identify advantages and disadvantages from a practical point of view.

The selected company is called “A”. As a result of a substantial reorganization during the years 2004 and 2005, “A”s operation is now focused on real estate development projects. In the year 2004, one residential project was commissioned and one commenced. In year 2005, “A” was involved in three on-going housing projects and three projects at the design phase. The process of land property purchases is continuous. The company management, responding to the growing competition and expansion of the construction activities, realised that the company needs a system, which helps organizing the every-day activities in order to reach the desired targets. In company “A”, there is a functioning financial management system. An integrated Management System is the defined target. The first step towards the target is establishment of the Environmental Management System, which can be integrated in the Total Management System.

4 METHODS

The process of writing the Thesis can be divided into two stages: first – clarification and evaluation of the established systems for environmental management; second – developing an approach for environmental aspect and impact identification and making suggestions for environmental strategy. Therefore, several research methods were used.

For proceeding with the first stage, a review of the legislation, standards, and literature has been performed. The chosen approach required study of relevant national and European Union legislation, as well as the International Standards. The legislation and standards provide a framework, which is necessary for establishment of a valid and legal Environmental Management System. The literature review provides an overview of other research and findings on relevant issues.

During the second stage of the Thesis, the obtained information regarding Environmental Management Systems was supplemented with information from the applied Expert Method. The Expert Method was used for understanding the process baseline of the company’s current situation. The acquired information was supplemented with site inspection observations. The Expert Method has been selected because it enhances qualitative evaluation of the current policy of the company and it contributes to the environmental aspect identification and significance ranking.

Further, in the particular section, each of the methods is described in more detail.

4.1 Review of Legislation and ISO 14001

The review of relevant European Union and Latvian legislation was prepared with respect to the environmental and quality management systems. As EMS requires, when recognizing critical effects and activities, the legislation governing construction business shall be used as the framework.

As the most important legislation governing establishment of EMS, the Regulation (EC) No 761/2001 of the European Parliament and of the Council of 19 March 2001 allowing voluntary participation by organisations in a Community eco-management and audit scheme (EMAS) shall be mentioned.

The Commission Decision 2001/681/EC of 7 September 2001 is guidance for the implementation of Regulation (EC) No. 761/2001. Regarding EMAS, there are Commission Recommendations 2003/532 of 10 July 2003 on guidance concerning the selection and use of environmental performance indicators (Text with EEA relevance) (notified under document number C (2003) 2253).

Regulation (EC) No. 761/2001 refers to the Community programme of policy and action in relation to the environment and sustainable development (OJ C 138, 17.5.1993, p. 1). The Regulation could be considered as the primary source. The Regulation No. 761/2001 Clause (2) states that the programme ‘Towards Sustainability’ (presented by European Union, the Commission and approved as to its general approach by the Resolution of February 1, 1993) “… emphasizes the role and responsibilities of organisations, both to reinforce the economy and to protect the environment throughout the Community” and (3) “calls for broadening the range of instruments in the field of environmental protection and for using market-mechanisms to commit organisations to adopt a pro-active approach in this field beyond compliance with all relevant regulatory requirements regarding the environment”. The Regulation limits itself to “ensuring an equal implementation of EMAS throughout the Community by providing for common rules, procedures, and essential requirements regarding EMAS, whilst the measures that can be adequately performed on a national level are left to the Member States” (Regulation (EC) No. 761/2001 Clause (8)).

Regarding the requirements for environment management system, the Regulation states that “In addition to the general requirements of the environmental management system, EMAS places special significance on the following elements: legal compliance, improvement of environmental performance and also external communication, and employee involvement” (Regulation (EC) No. 761/2001 Clause (17)). Article 3 of the Regulation “Participation in EMAS” lists the requirements for organisations, i.e., (a) conducted environmental review of its activities, products, and services and implements an environmental management system; (b) carry out environmental auditing; (c) prepare environmental statement and (d) environmental review; (e) prepare validated environmental statement. Article 10 of the Regulation “Relationship with other environmental legislation in the

Community” states that “EMAS shall be without prejudice to: (a) Community law, or (b) national laws or technical standards not governed by Community law, and; (c) the duties of organisations under those laws and standards regarding environmental controls” (Regulation (EC) No. 761/2001 Article 10)).

The Guidance for the implementation of Regulation (EC) No. 761/2001 has the aim “to ensure that Regulation (EC) No. 761/2001 is applied uniformly by all the Member States and for the establishment of the verification programmes of organisations under EMAS for conducting validations of environmental statements and subsequent yearly updates, as well as for exceptions to the principle of yearly validated updates” (2001/681/EC).

The purpose of the guidance requirements is to “… ensure that the organisation has management control and influence over its environmental aspects that have significant environmental impacts at all sites” (2001/681/EC; ANNEX I).

2003/532 Commission Recommendation concerning the selection and use of environmental performance indicators provides guidance on selection and use of environmental performance indicators for the EMAS Regulation. “Environmental performance indicators should be cost-effective and appropriate to the size and type of organisation and its needs and priorities” (2003/532 Commission Recommendation; Annex I).

As indicated in the Recommendation, the basic principles of the environmental indicator systems are (2003/532 Commission Recommendation; Annex I):

- Comparability: indicators should enable a comparison and show changes in the environmental performance,
- Balance between problematic (bad) and prospective (good) areas,
- Continuity: indicators should be based on the same criteria and should be taken over comparable time sections or units,
- Timeliness: indicators should be updated frequently enough to allow action to be taken,
- Clarity: indicators should be clear and understandable.

On 04.20.2004, the rules No. 320 of the Cabinet of Ministers of the Republic of Latvia were published, prescribing the procedure on how to establish and operate an environmental management and audit system register, referring to EC regulation No. 761/2001. The evaluation and registration of organizations according to EMAS and the law of the Republic of Latvia “On Environmental protection” is conducted by the Environment Impact Assessment State office.

When recognizing critical effects and activities, legislation governing construction business was consulted as a framework.

The international Standard ISO 14001 specifies requirements for an environmental management system, where an organisation should formulate a policy and objectives taking into account legislative requirements and information about significant environmental impacts, which can be controlled and over which it can be expected to have an influence (Svensk Standard SS-EN ISO 14001).

ISO 14001 is a voluntary internationally recognised standard for EMS’s. The standard specifies the actual requirements for an EMS. It applies to those environmental aspects, which the company can control and over which it can be expected to have an influence (Patel, 2005).

The ISO 14001 Standard consists of the Environmental Management System (EMS) specification and general requirements in five categories, which must interact in order for a company or other organisations to organise the environmental work (Brorson and Larsson, 1999). The requirements describe general outcomes of the system, but do not prescribe the specific approaches an organization must implement to get there.

A precondition for continuous development is a well founded and system-based strategy. In this particular thesis, the general guidelines for development of the construction industry are based on the European Union Strategy for Sustainable development (2001), the Lisbon Industrial Policy (2005), the Green Paper (2005), and the E-Core (2005).

4.2 Literature Review

The first task in the Thesis work was to study the entire system and logical map of available tools to be used for the EMS and position the

company’s ambitions therein. Such an approach provided an overview and helped avoiding gaps in further implementation stages. The Robe`rt and Schmidt-Bleek (2002) model for Strategic sustainable development is comprehensive and ensured achieving the objectives.

The strategic sustainable development model is “a planning approach that relies on continual consideration of the broader system in which specific actions are embedded” (Robe`rt and Schmidt-Bleek, 2002). As Robe`rt and Schmidt-Bleek (2002) introduces, the model clarifies “how many of the existing principles, strategies, and tools offer complementary and integrated methods for guiding strategic planning for sustainability”. The Strategic sustainable development model delineates interrelatedness between hierarchically different system-levels (Robe`rt and Schmidt-Bleek, 2002).

The analysis of ISO 14001 with respect to recognizing the weaknesses in the implementation process has been based on the Ghisellini and Thurston (2005) case study results “Decision traps in ISO 14001 implementation process: case study results from Illinois certified companies”.

A broader analysis has been made in the Thesis section, where an analysis of different EMSs has been made. The Brudick (2001) and Hertin and Berkhout *et al.* (2004) findings supplement the ISO and EMAS analytical description and can be considered as important milestones in reaching the Thesis objectives.

4.3 Expert Method and Site Inspection

The Thesis can be considered as a desktop study, supplemented with some field study elements, i.e., site inspections. The site inspections were made to verify the developed 2-Level Matrix and supplement it with Expert opinions. The Expert Method has been chosen because it enhances the qualitative evaluation of the company policy and contributes to the environmental aspect identification and significance ranking.

An expert (or Delphi) method is an approach to collecting and analysing opinions rather than data. It was developed at the Rand Corporation in the 1950s (Schmidt, 1997). The method is applied in cases where “judgemental information is indispensable” (Okoli, 2004). There are different variations of the method tailored to specific problem types and outcome goals.

One variant that has received widespread use is the ‘‘ranking-type’’ Delphi, used to develop group consensus about the relative importance of issues (Okoli, 2004).

In the Thesis, the Delphi method is used for recognising and ranking the environmental aspects.

The research activities in using the Delphi method can be divided into three phases according to Schmidt (1997): “(1) the discovery of issues, (2) determining the most important issues, and (3) ranking the issues.”

In the first stage, the experts are encouraged to identify “as many issues as possible”. In the Thesis, the discussed issues are the company’s environmental aspects. Afterwards, all aspects are listed and experts check whether their ideas are correctly represented. In the second stage, a list of the aspects is prepared in order to facilitate a ranking of them. In the third and final stage, the list is “arranged in random order”, and experts are asked to rank all the issues. The process can be repeated until consensus is reached.

5 FINDINGS

5.1 EMS Description and Analysis

The International Organization for Standardization (ISO), which is the developer of voluntary international standards, has 15 649 standards in its portfolio (on 31 December 2005) (International Organization for Standardization (ISO)). The division of standards by sectors is as follows (Table 2):

Table 2. Number of different standards elaborated through ISO.

Sectors as based on the International Classification for Standards (ICS)	**International Standards (total on 31 December 2005)**
Generalities, infrastructures and sciences	1 406
Health, safety and environment	658
Engineering technologies	4 099
Electronics, information technology and telecommunications	2 447
Transport and distribution of goods	1 710
Agriculture and food technology	954
Materials technologies	3 943
Construction	311
Special technologies	121
TOTAL	**15 649**

Source: International Organization for Standardization (ISO). Retrieved on April 11, 2006 from www.iso.org

According to the Institute of Environmental Management and Assessment (Baxter, 2005), the most frequently used Environmental Management Systems are ISO 14001:2004, Eco-Management and Audit Scheme (EMAS) and the so called “In-house EMS”.

In Latvia, until year 2004, ISO 14001 certificates were issued to 78 companies, but there were no EMAS certificates.

Table 3. Number of companies certified according to ISO 14001 and EMAS in different parts of the world.

	ISO 14001 (Year 2004)*	**EMAS (Year 2004)****
Worldwide	90569	-
Europe	30812	3072
Latvia	78	0

* Source: ACNielsen. (2004). The ISO Survey – 2004. *ISO Central Secretariat*, Switzerland. Retrieved on April 11, 2006 from www.iso.org

** Source: Eco-Management and Audit Scheme (2006). EMAS Statistics. Retrieved on April 11, 2006 from http://europa.eu.int/comm/environment/emas

In this section, the most frequently used tools, i.e., ISO and EMAS for environmental management will be described.

Generally, an organisation may choose to implement an environmental management system (EMS) for a variety of reasons (Baxter, 2005). There is a risk that expectations of the companies related to EMS will not be reached due to conceptual drawbacks, which will be described later. Patel (2005) summarised the following reasons, which motivate the companies to EMS implementation:

- Legal compliance, i.e., it creates awareness of environmental legislation applicable to the company so as to avoid any breaches and potential fines or prosecutions;
- Demonstrate environmental commitment and achieve environmental improvements;
- Satisfy customer expectations and provide the opportunity to use certification as a marketing differentiator;
- Reduce risks with regard to the environment;
- Improve commercial performance and enhance reputation;
- Obtain cost savings from reviewing and cutting energy and raw material consumption;
- Increasing employee motivation and enhanced personnel skills;
- Potential to take advantage of future incentive schemes, such as lower insurance premiums and improved access to finance, which may come into operation;

- Opportunity to integrate the EMS with other systems in operation on site to produce a streamlined approach to management.

Depending on the driving forces for EMS implementation and outlined targets, the nature of EMS is defined. Unfortunately, there are several drawbacks.

As Cerin (2005) and Hertin and Berkhout *et al.* (2004) stated, there is no clear correlation between the existence of an environmental management system (EMS) on one the hand and (a) a better environmental performance, (b) a better economic performance, or (c) a better overall performance on the other. A report by the Swedish environmental Protection Agency (Cerin, 2005) also states that it is difficult to distinguish a linkage between the implemented environmental management system and the improved environmental performance.

Several academic studies have indicated that an EMS does not in itself guarantee legal compliance and good environmental performance, fewer incidents or better environmental performance than those that do not have them (Dahlström *et al.* 2003).

Some critics argue that implementing an EMS will not achieve significant cost savings (Patel, 2005) and that the general performance evaluation systems have been developed by practitioners rather than academics (Kolk and Mauser, 2002). The environmental performance evaluation systems primarily serve these stakeholders’ own use of rating and benchmarking. Resulting from this specific interest on rating and benchmarking, there is an inherent risk of a vicious circle: ‘the subjectivity in formulating the rankings can give a rise to a dangerous circularity, whereby rankings are based partly upon reputation and reputation is partly based on rankings’ (Ilinitch *et al*. 1998).

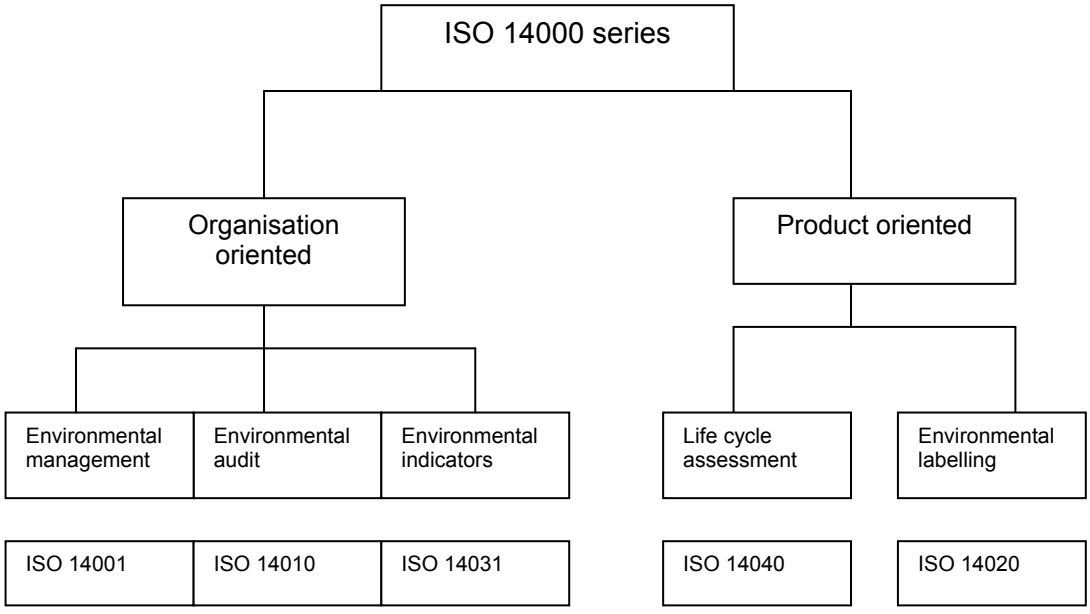
5.1.1 ISO 14001:2004 Description and Analysis

The International Standards (ISO) covering environmental management issues are intended to provide organizations with the elements of an effective environmental management system, which can be integrated with other management requirements, to assist organizations in achieving environmental and economic goals. The overall aim of this International

Standard is to support environmental protection and prevention of pollution in balance with socio-economic needs (Svensk Standard SS-EN ISO 14001).

The International Standard specifies requirements for an environmental management system, to enable an organisation to formulate a policy and objectives, taking into account legislative requirements and information about significant environmental impacts, which can be controlled and over which can be expected to have an influence (Svensk Standard SS-EN ISO 14001). Regarding the most important EMS components, ISO provides general classification guidelines.

Environmental performance indicators are subdivided into management performance indicators and operational performance indicators (inputs and outputs). In view of its focus on the provision of internal information, ISO 14031 does not cover communication to stakeholders (see Figure 1), although the data can be used for external disclosure (Kolk and Mauser, 2002).



Source: Brorson and Larsson (1999) p.16

Figure 1. The family of ISO 14000 series standards.

The ISO 14001 document entitled “Environmental Management System – Specification with Guidance for Use” is the centrepiece of the ISO series (Ghisellini and Thurston, 2005). According to this Standard, a company must commit itself to pollution prevention, regulatory compliance and

continuous improvement of its products, activities, and services. The EMS is used to achieve these goals and it follows the “plan, do, check, and act” model. Furthermore, EMS, which confirms to the ISO 14001 Standard, requires the following elements:

1. An Environmental Policy appropriate to the organisation’s activities, products, and services
2. A Planning process that identifies the environmental aspects and the legal requirements; implements and characterizes the company; implements environmental programs; addresses the significant impacts.
3. An Implementation system that includes the company structure of responsibility for the elements of EMS, employee training and awareness programs, an effective communication system, establishment of the EMS documentation, the identification of operational control procedures and energy plans.
4. A control and Corrective Action system that includes monitoring and measurement activities, non-conformance analysis, and corrective actions, management of the records, and scheduling internal and external audits of the EMS.
5. A Management Review, which checks and documents the adequacy and effectiveness of the EMS with a frequency established by the company itself.

In order to obtain ISO 14001 certification, a company should undergo a third-party assessment of its EMS by independent auditors associated with accredited registrars. After the first certification audit, other surveillance visits are performed, typically every six months, to verify that the company implements, controls, and improves its EMS. If a company does not comply with the EMS requirements, the registrator can withdraw certification. After a period of three years, a company must undergo a new certification audit (Ghisellini and Thurston, 2005).

5.1.2 EMAS Description and Analysis

EMAS - the Eco-Management and Audit Scheme established by European Regulation 1836/93 is a voluntary initiative designed to improve

companies’ environmental performance. Later it has been replaced by Council Regulation 761/01 (www.emas.org.uk; 29.01.2006).

Environmental policy instruments according to Hillary (1997) are classified as market-based instruments, such as eco-taxes, voluntary agreements between industrial and public authorities, and “informational devices”, such as eco-labels and environmental auditing schemes. EMAS is an EU market-based initiative. Market-based tools are expected to harness the creative energies of companies and direct them to improving the environmental performance of products and processes in a way, which has remained updated by the normative style of environmental legislation (Hillary, 1997 p.132).

The management system element of EMAS is based on ISO 14001. For those organisations that choose it, ISO 14001 can be a stepping-stone for progression to EMAS (Patel, 2005).

The aim of EMAS is to recognise and reward those organisations that go beyond minimum legal compliance and continuously improve their environmental performance. It requires that participating organisations regularly produce a public environmental statement that reports on their environmental performance. It is this voluntary publication of environmental information, the accuracy and reliability of which has been independently checked by an environmental auditor, which gives EMAS and those organisations that participate enhanced credibility and recognition (www.emas.org.uk).

From an EMAS point of view, minimising the amount of waste that is produced, reducing energy consumption, and making more efficient use of resources can all lead to financial cost savings, in addition to helping protect and enhance the environment. EMAS is strongly backed by Government and the environmental regulators - organisations that participate are recognised as making strong commitments to the environment and to improving their economic competitiveness (www.emas.org.uk).

EMAS begins with the requirement of environmental legislation and demands continuous improvement on the environmental front (Brorson and Larsson, 1999 p.17).

EMAS requirements:

1. Environmental policy
2. Environmental review (analysis of the current situation)
3. Established Environmental Programme for the site (it includes quantifiable objectives and measures to achieve these objectives)
4. Environmental control system (EMS; organisational plan, delegation of responsibility, procedures, working methods and resources)
5. Environmental audit
6. Environmental statement (shall be published)
7. System audited by environmental verifier
8. Statement shall be sent to registration body

5.1.3 EMS Analysis

As a theoretical framework for evaluating and planning an EMS, the strategic sustainable development model by Robe`rt and Schmidt-Bleek (2002) was used. It is a comprehensive sustainable planning approach that relies on continual consideration of the broader system, in which specific actions are embedded.

The strategic sustainable development model delineates interrelatedness between hierarchically different system-levels (Robe`rt and Schmidt-Bleek, 2002):

1. Principles for the constitution of the system (e.g. ecological and social principles);
2. Principles for favourable outcome of planning within the system (e.g. principles for sustainability);
3. Principles for a process to achieve this outcome (e.g., principles for sustainable development);
4. Actions, i.e., concrete measures that comply with the principles for the process to achieve a favourable outcome in the system (e.g., recycling and switching to renewable energy);
5. Tools to monitor and audit.

A developed systems perspective in methodical approach indicates relationships between existing tools and organizational perspectives.

Level 1 - Principles for the constitution of the system (e.g., ecological and social principles) - represent the system, on which the research focuses. The constitutional principles of the functioning of the system shall be comprehended. Principles like thermodynamics, biogeochemical cycles, ecological interdependencies of species, social exchange with and dependency on the ecosphere (Robe`rt and Schmidt-Bleek, 2002). Level 2 includes principles for favourable outcome of planning within the system (e.g., principles for sustainability). The first level principles, which describe fundamental processes in society, environment etc., and second level principles, particularly sustainability, are not reconsidered in this thesis.

Principles of the Strategic sustainable development model level 3, 4, and 5 are considered as guiding for evaluating existing principles, strategies, and tools of EMS. Principles for the process to achieve the results outlined in the second level (e.g., principles for sustainable development) are described in Level 3. According to Robe`rt and Schmidt-Bleek (2002), in this level focus is onto the process in order to reach the goal, i.e., move the society in the direction of sustainability. The actions should be fostered through process principles of strategic investments, social principles, and political means. Strategic investments principles should be selected by using Backcasting, Flexible Platforms, Good Return on Investment, and Precautionary Principles. Social principles prescribe that dialogue, encouragement, and transparency must be considered. Political means are perceived as differentiated taxes, subsidies, privileges, norms and standards, international agreements, legislation, trade and economic development.

Implementation of the 3rd level principles is performed by use of legislation and administrative tools. The business sector indirectly influences development of the 3rd level principles.

Level 4 - Actions, i.e., concrete measures that comply with the principles for the process to achieve a favourable outcome in the system (e.g., recycling and switching to renewable energy). Process principles are applied to foster concrete actions to eventually comply with the system conditions for sustainability within the ecosphere. It is important that activities are chosen and examined from a complete sustainability perspective. Compliance with all system conditions (System Conditions 1: Use of other materials from the

earth’s crust that are more abundant – or renewable; System Conditions 2: Use of other compounds that are either naturally occurring or easily degradable into such compounds; System Conditions 3: By dematerialization to phase out destructive interference with functions and evolution of ecosystem; System Conditions 4: dematerialization from a social perspective (health aspects related to ecological pollution)) is the strategic starting point for planning (Robe`rt and Schmidt-Bleek, 2002).

Level 5 - Tools to monitor and audit. Tools and metrics should be selected and designed from the same perspective as actions. Strategic tools should not only focus on current downstream problems, but also apply a sustainability perspective so that the long-term course will not culminate in unsustainable activities (Robe`rt and Schmidt-Bleek, 2002). The monitoring of the process should utilize tools and metrics that are designed from a total systems perspective to indicate and audit progress towards sustainability. Two levels are considered (Robe`rt and Schmidt-Bleek, 2002):

(i) The relevance of actions with reference to principles for the process (e.g., indicators of flows and key-figures to comply with principles for sustainability) and/or monitoring. The first focuses on evaluating how the actions comply with the overall plan and objectives, i.e., to monitor if the selected path of transition is actually bringing societies and the manufacturing sector closer to the objectives. This is a crucial level to monitor from a strategic point of view, since the monitoring of steps towards compliance with basic principles of success allows ”fixing” and avoiding problems.

(ii) The status of the system itself and impacts (e.g., eco-toxicity and employment) or reduced impacts, due to a strategically planned societal action. The second level monitoring is for the actual impacts in the system to be protected. It is as essential as the direct target of the planning. At the end, society as a whole needs to see success at this level.

There are different tools, which provide monitoring and auditing guidelines, e.g., Factor X (a direct way of utilizing metrics on various activities that can reduce the throughput of resources and energy in a given process, an indicator of progress), Life cycle assessment (a method applied if errors of

unknown magnitude are avoided in the assessment of the ecological stress potential of human activities, products and services, an indicator of progress), rucksack and MIPS (Material Input Per Unit Service), Total Material Flow (at the macroeconomic level used for monitoring of certain aspects of sustainability), and Ecological management systems (EMS, e.g., ISO 14001 and EMAS) (Robe`rt and Schmidt-Bleek, 2002).

Environmental management systems (EMS) are administrative tools for managing environmental work within a business or other institutions. The “Strategic sustainable development” decision-making model principles and activities must be put into a relevant administrative context. In order for the EMS to be useful in sustainable development and business, the objectives for planning and specific activities and associated metrics need to be incorporated into the structure of the EMS. A framework based on basic principles for sustainability and sustainable development provides the EMS with a direction and helps firms aligning the business with the larger context of sustainable development and changes in the market. Without such an administrative tool, it is difficult to implement comprehensive principles in an effective operational way (Robe`rt and Schmidt-Bleek, 2002).

The most commonly used EMS is ISO 14001. According to Ghisellini and Thurston (2005) case study results “Decision traps in ISO 14001 implementation process: case study results from Illinois certified companies”, there are recognised issues, which do not comply with the Strategic Sustainable Development Model prerequisites for sustainable development.

The Model requires that the principles for strategic investments are selected by principles, which avoid “dead ends” of investment and does not focus on downstream problems, i.e., there should be a possibility for continuous development. It is hard to realize whether the decisions are made based on ISO 14001. According to Ghisellini and Thurston (2005), ISO misleads the understanding of “prevention of pollution”. The intention of the Pollution Prevention Act (1990) was to stress attention to input materials rather than to dealing with output control approach. Ghisellini and Thurston (2005) hold the position that the Standard does not encourage companies to perform “root-cause” analysis of significant aspects. The result is that the attention is shifted “to the interaction between the aspect and the outer

environment and focusing on end-of-pipe solutions (Ghisellini and Thurston, 2005).

Ghisellini and Thurston (2005) offer possible measures to eliminate the above described discrepancy by performing “root-cause analysis on every significant aspect in order to identify hidden Pollution Prevention opportunities”. A wide range of environmental programs could help in the implementation of cost savings and environmentally friendly activities.

The process of assessing and identifying the environmental aspects and impacts and the methodology used to rank the significance of the aspects are fundamental stages of an EMS and may significantly affect estimates of the environmental performance. The Standard does not provide a rigorous definition of a significant aspect. Therefore, the initial assessment may not result in a rigorous environmental baseline and cannot be used afterwards to keep track of possible changes. Furthermore, the methods used in evaluating the aspects’ significance may be based on an inadequate set of criteria that do not accurately identify the real significance of the aspects (Ghisellini and Thurston, 2005). Failure to identify a rigorous environmental baseline is misleading the sustainable development process. The result of assessing and identifying the environmental aspects and impacts does not comply with the Strategic sustainable development model principles (level 4 and 5).

In order to ensure continuously improving environmental performance by implementing ISO, the following actions should be performed (according to Ghisellini and Thurston, 2005): after assessing the initial environmental baseline and identifying important metrics, an environmental program with the objective of continuously analyzing environmental performance over time should be set. This is one of the few “ongoing” objectives, since the other environmental programs deal with how to improve certain impacts and are characterized by specific deadlines and due dates. At every management review, the trend of the environmental performance should be analyzed and, if no improvement is achieved, corrective actions should be taken. In so doing, the entire management system will provide a direction for continual improvement of environmental performance and at the same time the company will fulfil its ISO 14001 requirements (Ghisellini and Thurston, 2005).

ISO 14001 does not require a clear definition of objectives and targets. The selected aims may not significantly address the environmental impacts previously identified (Ghisellini and Thurston, 2005). Therefore, it can be concluded that the “Strategic Sustainable Development” decision-making model 4 and 5 level principles are not taken into account.

Ghisellini and Thurston (2005) suggest: “in the definition of objectives and targets, the ISO team should pursue both medium-term and long-term projects. Management should encourage these initiatives and the representatives from engineering and manufacturing departments should apply their knowledge to find feasible solutions. Even if it is convenient to have a series of “ongoing” or short-term objectives, the company should not rely on them exclusively for pursuing larger scale environmental improvements.

There is a discrepancy between the Strategic Sustainable Development decision-making model principles and EMAS as well. Hillary discovered that Article 3a of EMAS states that the policy commitment to environmental performance improvement should have an aim to reduce “environmental impacts to levels not exceeding those exceeding the economically viable application of the best available technology (EVABAT)” – a way for companies to justify not setting ambitious targets (Hillary, 1997 p.140). Furthermore, EVABAT inappropriately introduces into the policy a concept stating that all improvements are dependent on being assessed against technology.

Beside the above-mentioned substantial drawbacks, ISO 14001 is criticized because of its “management” standard nature. It is not a “performance” standard. The commitment of continuous improvement is intended to be applied to the EMS itself and not to the actual environmental performance. A company can successfully implement ISO Standard/seek to certification without significantly changing its environmental impact (Ghisellini and Thurston, 2005).

Brudick (2001. p.39) has an opinion that the ISO 14001 standard does not differentiate between measuring continuous improvement by improvements in the environmental management system (system performance improvements) or in environmental performance from setting and

meeting objectives and targets for environmental impact reduction (environmental performance improvements). Measuring the environmental performance trough its reduction in impacts has a greater effect than measuring its system efficiency.

The main findings of the study, the aim of which was “to assess whether the existence of an EM on site could be used to extend “risk-based regulation”” (Dahlström *et al.* 2003) are as follows:

1) Sites with externally validated EMS tend to have higher levels of operator performance with respect to process/management issues (such as recording and use of information, knowledge and implementation of authorization requirements, plant maintenance, management, and training) and process operation but they do not have a lower likelihood of suffering from incidents, complaints, and non-compliance events;
2) There is no conclusive evidence to show that EMAS is better at inducing continuous improvement than ISO 14001 or vice versa;

Some critics argue that implementing an EMS will not achieve significant cost savings (Patel, 2005) and general performance evaluation systems have been developed by practitioners rather than academics (Kolk and Mauser, 2002). The environmental performance evaluation systems primarily serve for own use of these stakeholders for rating and benchmarking. Resulting from this specific interest on rating and benchmarking, there is an inherent risk of a vicious circle: ‘the subjectivity in formulating the rankings can give a rise to a dangerous circularity, whereby rankings are partly based upon reputation and reputation is partly based on rankings’ (Ilinitch *et al*. 1998).

The main deficiency of the models is in the operational inadequacy since the focus is on environmental management rather than on environmental performance. Environmental performance evaluation systems are developed by practitioners, i.e., consultants, banks, governments, NGO’s etc. to primarily serve for own use of the stakeholders for rating and benchmarking. This phenomenon of interest may “give a rise to dangerous circularity, whereby rankings are partly based upon reputation and reputation is partly based upon ranking” (Ilnitch *et al.* 1998). The adoption of the

Standard is primarily driven by business and marketing issues and does not imply an improvement in actual environmental performance (Ghisellini, 2005).

Focusing on regulatory compliance is evaluating in a different way: Brudick (2001 p. 45) and Ghisellini (2005) state that ISO 14001 requires that the organization makes a commitment to legal compliance but does not require full compliance with the existing environmental regulations. Companies may not appreciate this opportunity and regulatory compliance may become the dominant criterion in the evaluation of significant aspects and in the development of environmental programs. Companies may tend to react to legislation and lose the opportunity to address non-regulated impacts, such as the depletion of natural resources and the end-of-life product stewardship (Ghisellini, 2005).

By implementing EMS, resources are diverted too much to the documentation system: both ISO 14001 and EMAS specify establishment of numerous different procedures covering the entire spectrum of the EMS, which must be maintained and reviewed periodically to ensure continuous improvement of the system and to pass a third-party audit. This increases the amount of bureaucracy within the company.

The adoption of the Standard is primarily driven by business and marketing issues and does not imply an improvement in actual environmental performance.

5.2. Approach of Recognizing Critical Effects and Activities

5.2.1 Importance of Recognizing Critical Effects and Activities

The Strategic Sustainable Development Model system level 5 – “Tools to monitor and audit” (Robe`rt and Schmidt-Bleek, 2002) provides a theoretical background for the critical effects and activities recognizing process and classifies the recognized effects in two levels. The system level 5 prescribes that “monitoring of the process should utilize tools and metrics that are designed from a total systems perspective to indicate and audit progress towards sustainability”.

One of such tools providing monitoring and auditing guidelines is EMS.

The process of identifying and assessing environmental aspects and their impacts is an important cornerstone of an effective EMS. Equally important is the criteria to prioritize the significance of identified aspects (Brudick (2001) and Ghisellini and Thurston (2005) recognize that failure to identify actual aspect and effectively assess and rank their significance is leading to an ineffective and unsustainable system.

The company’s environmental policy and its environmental management system in general must be based on knowledge of all environmental aspects and significant environmental impacts, which can result from operations, products, and services. The company must investigate all the ways, in which its operations affect the environment, and the most important environmental aspects that have significant environmental impact must be identified. The environmental policy and other components of the environmental management system must be clearly connected to the significant environmental aspects (Brorson and Larsson, 1999, p.33).

The Strategic Sustainable Development Model, as described before, distinguishes two levels of monitoring and auditing tools:

(i) The relevance of actions with reference to principles for the process (e.g., indicators of flows and key-figures to comply with principles for sustainability), and/or monitoring (Robe`rt and Schmidt-Bleek, 2002).

(ii) The second level to monitor is the actual impacts in the system to protect (Robe`rt and Schmidt-Bleek, 2002).

In the strategic planning, a company should take into account the current acute problems that violate the system’s conditions (sublevel ii). Organizations often focus on specific and known effects in nature from various compounds and activities – looking downstream along the cause-effect chains. They lose sight of the principal levels (sublevel i) for long-term solutions – based on upstream thinking and prevention. The strategic tools should not only focus on the current downstream problems (ii), but also apply a sustainability perspective so that the long-term course would not culminate in unsustainable activities (i) (Robe`rt and Schmidt-Bleek, 2002).

The following description and classification is relevant for the management level, i.e. the (ii) level of monitoring and auditing tools.

In this particular case, where the company does not have any quality or environmental management system, the initial audit shall be performed. Therefore, it is important to create a set of environmental aspects and impacts, which are used for initial monitoring. The collected information helps constructing and determining the organizations’ environmental targets and objectives. In the next stages of EMS implementation - monitoring and auditing - generated data will become a significant contribution to the database, which was established during the initial auditing phase. In order to establish the database for evaluation of the organization’s activities, the aspects and impacts are recognized and ranked and the appropriate indicators chosen using a 2-level matrix. Such an approach follows a logical and theoretical model of hierarchy as suggested by Robe`rt and Schmidt-Bleek (2002) and Waage *et al.* (2005) and eliminates a too a significant focus on “end-of-pipe” solutions.

Before proceeding with a description of the EMS elements and avoid confusions, it is important to set forth certain definitions. EMAS and ISO 14001 provide the following definitions of the Environmental audit, monitoring and environmental targets, objectives, and impacts:

1. An environmental audit (according to EC No. 761/2001 definition; similar in ISO 14001) is a management tool comprising a systematic, documented, periodic, and objective evaluation of the performance of the organization, the management system, and the process designed to protect the

environment with the aim of: (i) facilitating management control of practices, which may have an impact on the environment; (ii) assessing compliance with the environmental policy, including environmental objectives and targets of the organization.

2. Monitoring within the scope of EC No. 761/2001 (Appendix A, I-A.5.1) (similar in ISO 14001) is understood as establishment and maintenance of documented procedures to monitor and measure “the key characteristics of its operations and activities that can have a significant impact on the environment”. This shall include the recording of information to track performance, relevant operation controls, and conformance with the organization’s environmental objectives and targets.
3. In the EC document No. 761/2001 (similar in ISO 14001), the environmental target is defined as “detailed performance requirement, quantified where practicable, applicable to the organization or parts thereof that arises from the environmental objectives and that needs to be set forth and met in order to achieve those objectives”.
4. The EU Regulation and ISO defines the environmental objective as “overall environmental goal arising from the environmental policy that sets itself to achieve and which is quantified where practicable”.
5. Environmental impact – any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation’s activities, products, or services [ISO 14001].
6. Environmental aspects in different sources are defined as follows:
    - Environmental aspects shall mean an element of an organization’s activities, products, or services that can interact with the environment (ISO 14001 and EMAS EC No. 761/2001).

- Environmental aspects are parts of an organisations’ activities, products, or services that can interact with the environment (Brorson and Larsson, 1999, p.34);

According to Brorson and Larsson (1999), the listed areas of concern and relevant aspects correspond to the Strategic Sustainable Development Model system-level 5 – “Tools to monitor and audit” the management sub-level (ii). Areas of concern are as follows (Brorson and Larsson, 1999 p.36):

- Controlled and uncontrolled emissions to the air;
- Controlled and uncontrolled discharges to water;
- Solid and other waste;
- Contamination of soil;
- Use of soil, water, fuel, energy, and other natural resources;
- Noise, smell, dust, vibration, and visual problems;
- Effects on specific parts of the environment, such as the recipient of wastewater.

Annex VI of the EC No. 761/2001 prescribes that an organisation’s direct and indirect aspects shall be considered. The Regulation prescribes that an organization shall “establish and maintain procedure to identify the environmental aspects” (Annex I, I-A.3.1). The company must deal with the environmental impact that can result from (Brorson and Larsson, 1999 p.36):

- Normal operating conditions;
- Abnormal operating conditions;
- Accidents and potential emergencies;
- Previous and future operations;
- Start-up and shutdown conditions (EC No 761/2001 Annex VI).

5.2.2 Methodology of Identifying Environmental Aspects and Impacts

The critics of ISO 14000 consider that the standard focuses on “end-of-pipe” solutions. One conceptual reason to this is lack of a root-cause analysis. Therefore, it is important to follow logical and theoretical model of hierarchy as suggested by Robe`rt and Schmidt-Bleek (2002) and Waage *et al.* (2005).

The Strategic Sustainable Development Model introduced by Robe`rt and Schmidt-Bleek (2002) has been used by Waage *et al.* (2005) and Geiser

et al. (2005) as a basis for developing criteria for assessing products in terms of sustainability factors. A set of sustainability-related criteria and characteristics would identify the indicators. It could be used as a track between actions and tools (level 4 and 5). The criteria “translate” the set of actions into a set of clear indicators. The proposed selection of the criteria and characteristics “can be based on both a synthesis and aggregation of the existing analytical work, including consideration of the broader system dynamics and environmental and socially screened characteristics”. The suggested set of criteria include:

- “Decreased (systematically) flow and volume of materials and products in relation to key sustainability factors (e.g., human exposures, resource availability for specific communities, waste assimilation etc.);
- Used materials and inputs that are:
    (a) non-toxic, persistent, non-bioaccumulative, non-fossil fuel-based, non-endocrine disrupters, non-ozone depleting, and
    (b) harvested and/or produced by using more sustainable practices (as defined within specific sub-fields);
- Relied on efficient, renewable, and sustainable sources of energy”.

As the Waage, S.A. notes, these criteria have “key gaps, particularly related to social aspects of sustainability and landscape level issues”. Due to the broad range, the challenge is to consider these aspects systematically and not to lose the overview. Generally, the guidelines about social aspects of sustainability include human rights, labourer/worker rights and access issues, social capital development and socio-economic elements of sustainability. The Landscape-level factors and impacts could be classified as suggested by Waage *et al.* (2005), Geiser *et al.* (2005):

- Spatial aspects to ecological structure, functions, and diversity. “Research in this field has shown that landscape connectivity is a critical determinant of species survival, which in turn relates to

overall ecosystem diversity and resilience”. There are spatial factors that are relevant to understanding and assessing cumulative effects.

- Regional ecosystem that shapes the relative sustainability of various material, product, or other decisions in specific contexts.

Stakeholder identification and incorporation of their interests into the EMS increases the system credibility and eliminates gaps in the aspect identification and ranking process. “Aspect and impact assessment methodology that includes additional criteria of interested parties and biodiversity concerns and the use of environmental expertise making difference between certified companies and environment management systems’ sustainability” (Brudick, 2001 p. 34). A systems’ response to stakeholder interests increases confidence of the involved parties.

According to ISO 14031 (Wathey and O’Reilly, 2000, p.34), common sources of environmental issues and pressures can be distinguished:

- Global environmental issues
- Political responses to environmental issues
- Social reaction to the environment
- Technical advances and scientific discoveries
- Economic influences
- Judicial liability
- Financial risks
- Moral accountability
- Financial performance
- Market forces
- Views of the interested parties
- Corporate values and aspirations

The previously described guidelines can be implemented using several methods. The environmental aspects can be identified on a procedure based on the Inventory Method (Ghisellini and Thurston, 2005), where process maps indicating all the activities, materials, products, and processes that interact with the environmental aspects were created. It can be supplemented by identification of terms of inputs (energy, raw materials etc.) and outputs

(Ghisellini and Thurston, 2005). ISO 14001 (Annex A, sub-clause 3.1) states that “the process to identify the significant environmental aspects associated with the activities at operating units should consider (on normal operating conditions, shut-down and start-up, reasonably foreseeable emergency situation):

- Emissions to air;
- Emissions to water;
- Waste management;
- Contamination of land;
- Use of raw materials and natural resources;
- Other local environmental issues.

In addition to the above-mentioned EU regulation EC No. 761/2001, list direct and indirect aspects. Consideration of both direct and indirect aspects is a significant part of the root-case analysis and baseline establishment. As direct environmental aspects in EC No. 761/2001 are defined aspects, which “cover the activities of an organization over which it has management control and may include:

- Emissions to air;
- Emissions to water;
- Avoidance, recycling, reuse, transportation and disposal of solid and other wastes, particularly hazardous waste;
- Use of natural resources and raw materials (including energy);
- Local issues (noise, vibrations, odour, dust, visual appearance, etc.);
- Transport issues (both for goods and services and employees);
- Risk of environmental accidents and impacts arising, or likely to arise, as consequences of incidents, accidents and potential emergency situations;
- Effects on biodiversity”.

As indirect environmental aspects in EC No. 761/2001 are defined aspects, which are “as a result of the activities, products, and services of an organisation there maybe significant environmental aspects, over which it may not have full management control”. These include:

- Product related issues (design, development, packing, transportation, use, and waste recovery/ disposal);
- Capital investments, granting loans, and insurance services;
- New markets;
- Choice and composition of services (e.g., transport or the catering trade);
- Administrative and planning decisions;
- Product range compositions;
- The environmental performance and practices of contractors, subcontractors, and suppliers”.

The above-mentioned elements combined within an adapted version of the “strategic sustainable development” decision-making model made by Waage et al. (2005). “The flow – from outcomes/success principles, to strategy, actions, criteria, and tools - shows the nested decision-making approach suggested as a pathway forward for business decision-makers seeking to integrate sustainability factors”.

5.2.3 Methods Used in Evaluating the Aspects’ Significance

The lack of criteria that accurately identify the significance of aspects is recognized by the critics as a conceptual ISO 14000 drawback. ISO 14001 itself does not provide a specific guidance on how to identify the aspects and impacts or how to determine the significance thereof (Brudick, 2001 p.57). Therefore, it is important first to choose an approach and criteria for evaluation of significance. The available methods of assessment of aspect significance are divided into three different approaches (Zobel, 2004 referring to Woodside):

1. Consideration of the selected documented criteria without any weighing factors,
2. Consideration of the selected documented criteria with weighing factors, and
3. Evaluation by environmental professionals.

The most commonly suggested significance assessment criteria are (Zobel, 2004):

- The scale of the impact;

- The severity of the impact;
- The probability of occurrence;
- The permanence of impact;
- The actual or potential regulatory/legal exposure;
- The difficulty of changing the impact;
- The concerns of stakeholders.

The aspect should automatically become a significant environmental aspect if it is associated with environmental concerns and legislative requirements or if there is a lack of information based on which to make a satisfactory appraisal (Zobel, 2004 referring to Whitelaw).

The existing methods for aspect assessment are grouped into the following categories (Zobel, 2004):

1. Not a tool, but contains documented assessment criteria;
2. A tool with several assessment criteria. Each criterion is assigned a value from a scale and the total sum is calculated;
3. A tool with several assessment criteria. Each criterion is assigned a value from a scale and the numbers are multiplied;
4. A tool with several assessment criteria, but with different criteria depending on the type of environmental aspect;
5. A tool for traditional risk assessment;
6. Assessment based on LCA-data.

However, ISO 14031 (Wathey and O’Reilly, 2000 p.83) provides a generic overview of commercial drivers of environmental significance. Following, five “drivers” are recognized:

1. Risk – legal (risk of prosecution, fines, legal fees, damage to corporate image); financial (loss of stock, asset damage, loss of sales, downtime in operation); moral (damage to corporate or brand image through current practices, loss of sales);
2. Financial Performance – Financial implications are related to savings by reducing resource consumption, waste management, treatment and disposal; savings or revenues from reuse of waste or obsolete products; savings through redesigning and changing ways of working;

3. Marketing – new market opportunities can be realised by improving the environmental impact of a product or service, adding value to a product by improving environmental and cost performance in use or at end of life.
4. Views of Interested Parties – internal (for example, owners, top management, partners, functional management, employees, contractors, temporary and agency staff) and external (for example, customers, suppliers, investors, insurers, enforcement bodies, local authorities, local communities, pressure groups, trade unions, trade associations, industry bodies, education establishments);
5. Corporate Values are implemented in daily activities trough goals, aspirations, expectations, environmental performance criteria, traditions, ethos, social trends and norms, and cultural beliefs.

Annex VI of EC No. 761/2001 with respect to identifying the significance states that “it is the responsibility of the organisation to define the criteria for assessing the significance of the environmental aspects of its activities, products, and services, to determine the activities having a significant environmental impact. The criteria developed by an organization shall be comprehensive, capable of independent checking, reproducible, and made publicly available.” Based on these criteria, the Community legislation organization should decide which of its environmental aspects have a significant impact.

As Annex VI of EC No. 761/2001 suggests, the considerations in preparation of establishing a significance assessment of criteria for environmental aspects may include:

- “Information about the conditions of the environment to identify activities, products, and services of the organisation that may have an environmental impact;
- The organisation’s existing data on material and energy inputs, discharges, waste, and emissions in terms of risk;
- Views of the interested parties;

- Environmental activities of the organisation that are regulated;
- Procurement activities;
- Design, development, manufacturing, distribution, servicing, use, re-use, recycling, and disposal of the organisation’s products;
- Those activities of the organisation, which induce the most significant environmental costs and environmental benefits”.

Determination of significant aspects is relative to the environment and thus must be judged relative to environmental considerations. Determination of objectives, on the other hand, is relative to what business can and is willing to do, and allows for financial and other considerations to affect the decision on what is ultimately chosen to work on (Brudick, 2001 p.57).

The European accreditation guidelines specifically require the registrar to both insure that the procedure for identifying aspects and their impacts and that the criteria for determining significance are sound. These guidelines further clarify that it is up to the organization to define the criteria, by which environmental aspects and their associated impacts are identified as significant, and to develop procedures for doing this. However the registrar must raise objections if the procedure or the results of their application is not consistent with the organization’s policy, objectives, and targets (Brudick, 2001, p.56).

When rating the significance, numerical scores can be applied or colours, symbols, letters, or any other defining marks to identify a significance rating (Wathey and O’Reilly, 2000).

5.2.4 Selection of Relevant Indicators

The indicators summarise extensive environmental data to a limited number of significant key information sets (Commission Recommendation 2003/532, Annex I). The indicators track performance against key environmental aspects and impacts. The function of the environmental indicators is to assist organisations in the management of their environmental aspects and impacts (Commission Recommendation 2003/532, Annex I).

The Commission Recommendation 2003/532 of 10 July 2003 on guidance for implementation of the Regulation (EC) No. 761/2001 of EMAS concerning the selection and use of environmental performance indicators (Annex I) suggests that indicators should be “cost-effective and appropriate to the size and type of organization and its needs and priorities. They should primarily address those environmental impacts that are the most significant and that the company can influence by its operations, management, activities, products, and services”.

In Annex I of the Commission Recommendation 2003/532, the basic principles of an environmental indicator system are listed:

- “Comparability: indicators should enable a comparison and show changes in the environmental performance,
- Balance between problematic and prospective areas,
- Continuity: indicators should be based on the same criteria and should be taken over comparable time sections or units,
- Timeliness: indictors should be updated frequently enough to allow to be taken into consideration,
- Clarity: indicators should be clear and understandable”.

5.3 Suggestions for an Environmental Management System

The intent of the Thesis is to find an approach to environmental aspect and indicators identification. It has been considered as an important task due to serious critics towards lack of a rigorous environmental baseline and focus on “end-of-pipe” solutions of the current EMS. A comprehensive and continuous system can be established when the starting point, i.e. the baseline is described and measured using the same method and instruments, i.e., aspects and indicators. As described in Chapter 5.2 of the Thesis, a fundamental issue during EMS implementation is identification of a company’s environmental aspects and relevant indicators. Therefore, a 2-Level Matrix has been created. It is a comprehensive approach for environmental baseline identification, which avoids a significant weakness of current EMSs and can be used during the EMS implementation. It has been constructed by taking into account the objective to use it for identification of the baseline for an Integrated Management System.

This chapter illustrates how the 2-Level Matrix is established and how the information obtained can be used for environmental review preparation. The analysis of 2-Level Matrix results is made from a management strategic point of view. The suggestions for the company’s integrated EMS are prepared.

5.3.1 Approach for Environmental Baseline Identification

At first, the construction process is structured using an Inventory Method (Ghisellini and Thurston, 2005) and supplemented by identification of terms of inputs and outputs. According to the Ghisellini and Thurston (2005) approach, the Inventory Method is based on a process map. For the construction process, the following main process phases can be distinguished:

1. Idea Development
2. Location alternatives
3. Designing
4. Construction

In each stage of construction development, there are several interested parties and stakeholders involved. Therefore, the next step is to prepare the

stakeholders’ list. It is made by using the experts’ method and supplemented by findings from a review of legislation and other requirements. Taking into account the stakeholder interests is important for an EMS in order to create a sound EMS development.

The third step is to determine the sources of environmental issues and pressures. Common sources of the environmental issues and pressures, aspects and impacts were distinguished according to the theoretical framework (Wathey, 2000 p. 98). The environmental issue and pressure list was supplemented by findings from a review of legislation and other requirements.

The next step is to identify aspects and impacts of the construction process. According to EC No. 761/2001, the company’s environmental aspects and impacts and the company’s consumption of energy and raw materials are divided into inputs/outputs and direct/indirect environmental aspects. The existing procedures for dealing with environmental issues, legislation and other requirements were taken into account by developing a matrix.

The result of the above-described procedures is the following table (Table 4), which frames the firsts level of the 2-Level Matrix.

Table 4. The first level of the 2-level Matrix for aspects identification.

No.	Process phase	Sources of Env. issues and pressures	Interested parties and stakeholders	Inputs		Outputs	
				Direct env. aspects	Indirect env. aspects	Direct env. aspects	Indirect env. aspects
1	Development idea						
2	Location alternatives						
3	Designing						
4	Construction						

In next stage, the matrix was generalized and two main phases of the construction process distinguished: the construction process development idea and location alternative consideration phase was joined in one; design and construction phases were added to the second phase – construction phase (Table 5).

Table 5. The simplified first level of the 2-level Matrix.

No.	Process phase	Sources of Env. issues and pressures	Interested parties and stakeholders	Inputs		Outputs	
				Direct env. aspects	Indirect env. aspects	Direct env. aspects	Indirect env. aspects
1	Development idea and location alternatives						
2	Designing and construction						

During consolidation, the issues were expressed more generically. The approach “from details to generic” allows systematizing the environmental aspect identification and evaluation process. The detailed approach ensures that important indicators are recognized and no important aspects forgotten.

At the first level for each construction process phase, the relevant environmental aspects and impacts are identified. The information describes the current activities and environmental awareness of the company, as well as legislation demands and market trends. The evaluation of the significance of the recognized inputs’ and outputs and direct/indirect environmental aspects has been performed at the first level of the matrix.

After identifying environmental aspects and selection of sources of the environmental pressures and listing stakeholders, the impacts shall be determined. It is performed from the perspective of the interested parties and stakeholders.

Previously it has been described how the sources of environmental pressures and aspects, construction process phases, and stakeholders were identified. In the next step, the aspect ranking method is defined. As an appropriate approach for aspect significance assessment, an approach has been chosen where the selected criteria have certain weight factors, i.e., the importance has been measured. The aspects were divided into three classes:

Class 1 – Use of natural resources and raw materials (including energy), emissions to water, solid, hazardous, and other waste, risk of environmental accidents and impacts (consequences of incidents, accidents, and emergency situations).

Class 2 – Emissions to air; direct environmental aspects of output; indirect environmental aspects of output.

Class 3 consists of indirect environmental aspects of input; Landscape aspects and Local issues (noise, vibrations, odour, dust, visual appearance, etc.) are included.

The aspects of the first class are considered as the most important and are influenced by management decisions. The aspects are grouped as the first class because:

- The used materials are the core elements, which influence the construction project costs, construction impacts, and building operation/maintenance aspects. These aspects are interrelated and mainly linked to decisions regarding resource and material use. Waste amount and type is significantly changing depending on the selected materials and consumed resources. The chemical composition and quality of the material influences the volume and polluting character of releases to water. Therefore, the significance of environmental accidents is influenced as well. It may be concluded that the resource and material use frames the company’s environmental, quality, and financial performance.
- The selected materials are directly related to the construction approach, releases to water, and waste volume. The consumed and discharged waster volume, chemical composition and applied treatment procedure are issues of management decisions. Waste management represents the company politics on environmental issues.
- Environmental accidents have a high risk of occurrence, hazardous and permanent influence and require extensive mitigation measures. A company has a possibility to take all measures in order to prevent environmental accidents and therefore frame the environmental strategy.

Aspects of the second class have significant impacts but there are difficulties of exact impact determination and mitigation measures to be taken.

Aspects grouped in the third class have a comparably minor scale and impact. Effective mitigation measures can be taken. The third class aspects are related to other aspects, which are grouped in the first class.

By considering the significance of each aspect from a particular stakeholder point of view in Chapter 5.2.3 of the described Annex VI of EC No. 761/2001, suggestions were taken into account. Marks 1 to 3 (1 is given when there is significant level of concern; 2 – important but not crucial; 3 – no significant concerns) are given. Each stakeholder evaluates all aspects and an opinion is assigned with a value on a scale from 1 to 3 and the numbers are multiplied.

The aspects with the lowest score are considered as the most significant.

The approach outlines the most significant aspects and contributes in the decision making process. At the same time, it does not allow to oversee other aspects, which are significant but secondary.

Resulting from the evaluation procedure, the company’s operational environmental aspects should be incorporated into the environmental plan. The environmental plan is supplemented with the information about measurable indicators from the 2nd level of the matrix.

On the second level from the identified aspects, measurable indicators are obtained. Indicators are chosen according to the theoretical framework described in Chapter 4.2.4.

The approach, where the generic conclusions from a detailed baseline are drawn, provides a solid ground for setting different target levels during the planning stage. The information obtained from the matrix is used for determining different level objectives. The matrix facilitates establishment of an integrated environmental management system.

5.3.2 Environmental Review Preparation on Base of 2-Level Matrix

The environmental review covers the following issues (Brorson and Larsson, 1999):

- Review of legislation and other requirements
- Review of the company’s environmental aspects and impacts
- The company’s consumption of energy and raw materials

- The impact of environmental issues on the choice of the used methods, approaches
- The environmental work of suppliers and contractors
- Prevention and limitation of environmental accidents
- Review of existing procedures for dealing with environmental issues
- Analysis of business potential
- Analysis of views of the interested parties.

The 2-Level Matrix covers issues related to legislation and other requirements, the company’s environmental aspects and impacts; the company’s consumption of energy and raw materials; the environmental work of suppliers and contractors; prevention and limitation of environmental accidents; an analysis of views of interested parties is included.

5.3.2.1 List of Stakeholders

A list of stakeholders was established for phase 1 and 2 respectively (Table 6), by taking into account the commercial drivers of environmental significance (Wathey and O’Reilly, 2000 p.83) and the legislation requirements.

Table 6. List of stakeholders for phase 1 and 2 in a construction project.

Phase 1 **Idea development and alternative location consideration phase**	**Phase 2** **Design & construction phase**
Neighbours	Company’s management
Company’s management	Environmental board
Environmental board	Neighbours
Competitors	Potential inhabitants
Municipality	Government
Potential inhabitants	Municipality
Service providers	Competitors
Government	Employees
	Cultural heritage protection board
	Service providers
	Fire fighters
	Sub-contractors and suppliers

In phase 1, the strategic decisions about development project function, target group and possible location environmental aspects are taken. The chosen stakeholder group will require an appropriate project quality. Prevalent

and framed environment conditions will influence the stakeholder group preferences.

The most concerned stakeholders in phase 1 are neighbours. The environmental aspects about which the local community in the development area is concerned cover direct environmental aspects such as those related to emissions to water, waste collection and disposal, used materials and resources. Due to the many uncertainties of how the potential project will affect everyday life in the neighbourhood and the importance of visual impacts according to different studies, neighbours are considered as a more important stakeholder group than the company management.

For all stakeholders, including neighbours, the risk of environmental accidents is the main issue of concern. Indirect environmental aspects like the effect on living environment quality, increased air and noise pollution have been appointed the second level of concern.

The company management holds responsibility for the success of new development projects. Environmental aspects, which are closely linked to the success of a project, are important to the company management.

Power, water etc. communication establishment, material transportation, logistic network establishment is one of the issues, which is investigated before making the final decision for a development project. Waste type and volume collection, disposal, and recycling requirements are taken into account when strategic decisions about quality level and used materials are taken.

While preparing the environmental plan, it is important to perform a more detailed analysis of aspects, which influence the score in a significant way. It is necessary for a logic balance between ambitions of different stakeholders. The environmental board, the municipality, and the government hold a legal responsibility for influencing the development plan in the environmental area. Competitors are mostly concerned about environmental aspect influence on own projects and generally on the construction market.

In phase 2, tactical and operational decisions corresponding to a strategic level regarding environmental impact are taken. In the strategic planning, the chosen quality level prescribes design solutions, types of used

construction materials and construction techniques. Subcontractors and suppliers are selected by considering all of the above-mentioned.

The character of the design & construction phase is more specific; therefore, the stakeholders have particular issues of concern and environmental aspects can be transformed into a set of measurable indicators.

The scores for the company’s management, environmental board and neighbours are close to each other. The differences normally appears in input direct and indirect environmental aspects (as well as for output) and local issues consideration.

The most important aspects for a company’s management are emissions to water, legal compliance and awareness of interactions; collection, sorting, disposal and recycling of waste; use of dissoluble materials (insulation, chemical compounds). The use of safe approaches and materials, while assuring that the project is well insured and that persons involved use an effective construction approach are important for handling environmental risk aspects. Good quality materials, good equipment and design with respect to climate conditions influence the use of natural resources and raw materials (including energy).

The environmental board of the company is predominantly concerned about wastewater amount and chemical compounds, as well as control of other discharges. Collection, sorting, disposal, and recycling requirements for waste and usage of materials and approaches are matters of concern as well. The environmental board is following soil and ground water contamination, quality of ground water and water table change.

Important aspects for neighbours are emissions to water, collection of solid, hazardous, and other waste and effects of accidents on the surroundings and own property. Besides the fact that potential inhabitants are concerned about a clean environment, i.e. water, soil, flora etc., material quality, anthropogenic load and operation, maintenance costs are issues to be considered.

The government and municipality hold a legal responsibility to ensure safe constructions and avoid harm to environment and humans. The

construction board is an institution, which has control of design and construction quality.

Competitors’ interest is focused on compliance of legal requirements. Construction of competitor objects may be affected in case of close location.

For employees it is important that design and work practices do not endanger own health and safety. The construction process impact on the environment for employees is important and this holds for other stakeholders as well.

The Cultural Heritage Protection Board besides approving the planning act and design does not have any legal instruments to influence construction. Service providers issue technical requirements for safe provision of services and quality demands (e.g. wastewater amount and chemical compounds). Construction and water source accessibility are issues that the fire fighters are concerned about. Fire fighters check design safety before and after construction works. Sub-contractors and suppliers have similar issues of concern like the general contractors.

5.3.2.2 Sources of Environmental Issues and Pressures

Sources of environmental issues and pressures are identified by taking into account the suggestions of ISO 14031 described in Chapter 5.2.2 and the need to integrate the EMS into the integrated EMS.

For each phase of Matrix development, the following sources of environmental aspects and pressures are relevant (Table 7):

Table 7. List of important aspects and pressures for phase 1 and 2 of the construction process.

Phase 1 **Idea development and alternate location consideration phase**	**Phase 2** **Design & construction phase**
Corporate values and aspirations	Corporate values and aspirations
Legal liability	Economic influences
Social reaction to the environment	Legal liability
Financial performance	Financial performance
Economic influences	Global environmental issues
Political responses to environmental issues	Social reaction to the environment
Technical advances and scientific discoveries	Technical advances and scientific discoveries
Global environmental issues	Market forces
Market forces	

5.3.2.3 Indicators

According to the indicator selection methods used and identified environmental aspects (Matrix 1st level) described in Chapter 5.2.4, groups of indicators are determined (Matrix 2nd level).

Groups of indicators are the same both for the first and second phase: they provide comparable information for construction idea, design, and construction phases. The approach contributes to evaluation of the company’s environmental performance and decision-making process. It provides an option to analyze whether the construction has been executed as planned at the first strategic level, i.e. idea development and recognized deviations.

At the 2nd level of Matrix development, the following 4 groups of indicators are important:

- Energy performance of buildings;
- Input material and waste balance;
- Consumed and discharged water balance;
- Environmental accident impact.

The selected groups of indicators track performance against the 1st class environmental aspects (use of natural resources, materials and energy; emissions to water; waste; risk of environmental accidents).

The indicator “Energy performance of building” has been selected because it provides information about several environmental aspects and is a critical indicator for tracking performance on greenhouse gas emissions reduction.

The European Climate Change Programme (ECCP) II (October 2005) explores further cost-effective options for reducing greenhouse gas emissions in synergy with the EU’s “Lisbon strategy” for increasing economic growth and job creation. The strategy was implemented among others with the EU Directive 2002/91/EC “Energy performance of buildings”. It is based on an EU-wide common methodology to measure the energy performance of buildings.

The Directive provides a definition of “energy performance of a building”, i.e., “the amount of energy actually consumed or estimated to meet the different needs associated with a standardised use of the building, which may include, inter alia, heating, hot water heating, cooling, ventilation and lighting. This amount shall be reflected in one or more numeric indicators which have been calculated, taking into account insulation, technical and installation characteristics, design, and positioning in relation to climatic aspects, solar exposure and influence of neighbouring structures, own-energy generation and other factors, including indoor climate, that influence the energy demand” (2002/91/EC “Energy performance of buildings”).

In the appendix to the Directive 2002/91/EC, a general framework for the calculation of energy performance of buildings is provided. The methodology mentioned includes aspects both for the 1st and 2nd phase of matrix development.

While calculating the expected energy performance of buildings in the idea development phase, aspects like position and orientation of buildings, passive solar systems and solar protection and district or block heating and cooling systems shall be considered.

The following aspects shall be considered in calculating the energy performance of buildings in the design and construction phase:

- Thermal characteristics of the building;
- Heating installation and hot water supply, including their insulation characteristics;
- Air-conditioning installation;
- Ventilation;
- Built-in lighting installation
- Natural ventilation;
- Indoor climatic conditions, including the designed indoor climate.

According to the appendix of the Directive, the positive influence of the following aspects shall be taken into account, where relevant in this calculation:

- Active solar systems and other heating and electricity systems based on renewable energy sources;

- Electricity produced by CHP;
- Natural lighting.

The second and third group of the indicators are “Input material and waste balance” and “Consumed and discharged water balance”. In the design and construction phase, the indicators shall provide an overview of whether water and materials are used efficiently, environmentally friendly, and safely. At the strategic level, these indicators contribute to the planned object feasibility studies.

“The environmental accident impact” group indicators are the most difficult to define, but are important. Consideration of possible environmental accidents, impacts thereof and mitigation measures increases the company’s awareness. Inclusion of these aspects in the environmental strategy provides a different perspective when location, materials, and the construction approach are selected.

As suggested in Annex I of the European Union Commission Recommendation 2003/32, the indicators in the above-mentioned groups are comparable, continuous, clear, and balanced between the problem and prospective areas.

5.3.3 Core Elements of Environmental Strategy

A precondition for continuous development is a well-considered and system-based strategy. By determining the strategy, the current situation and circumstances in a company, as well as the general market and legislation development should be taken into account. With assistance of the above-described 2-Level Matrix, the situation in the company is fixed. For understanding the construction industry development trends the European Union Strategy for Sustainable development (2001), the Lisbon Industrial Policy (2005), the Green Paper (2005), and the European Construction Research Network (2005), general guidelines are used.

The European Union, in the capacity of being an active global political and economic participant has declared the following in “A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development” (2001): “The European Union has a key role in bringing about sustainable development, within Europe and also on the wider global stage, where

widespread international action is required” (“A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development” (2001)).

The European Union commitment to sustainable development is considered as the starting point for setting strategic goals. The European Council new strategic goal for the Union is “to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion” (Lisbon 2000).

In the Strategy, the main threats to sustainable development are stated. It can be recognized that all of the threats are directly or indirectly related to the construction industry. The Strategy summarises the following main threats:

- Emissions of greenhouse gases from human activity are causing global warming. Climate change is likely to cause extremer weather events (hurricanes, floods) with severe implications for infrastructure, property, health, and nature.
- New antibiotic-resistant strains of some diseases and, potentially, the longer-term effects of the many hazardous chemicals currently in everyday use pose severe threats to public health; threats to food safety are of increasing concern.
- One in every six Europeans lives in poverty. Poverty and social exclusion has enormous direct effects on individuals such as poor health, suicide, and persistent unemployment. The burden of poverty is borne disproportionately by single mothers and older women living alone. Poverty often remains within families for generations.
- While increases in life expectancy are obviously welcome, combined with low birth rates the resultant aging of the population threatens a slowdown in the rate of economic growth, as well as the quality and financial sustainability of pension schemes and public health care. Spending could increase by up

to 8% of gross domestic product in many Member States between 2000 and 2040.

- The loss of bio-diversity in Europe has accelerated dramatically in recent decades. Fish stocks in European waters are near collapse. Waste volumes have persistently grown faster than GDP. Soil loss and declining fertility are eroding the viability of agricultural land.
- Transport congestion has been rising rapidly and is approaching gridlock. This mainly affects urban areas, which are also challenged by problems such as inner city decay, sprawling suburbs, and concentrations of acute poverty and social exclusion. Regional imbalances in the EU remain a serious concern.

Corresponding to the action plan of the Sustainable Development Strategy, relevant policies are designed. Particularly regarding construction industry, the Industrial Policy shall be considered as rolling. The EU focus is on “economic growth and jobs within the context of the EU’s Sustainable Development Strategy, which aims to ensure that all EU policies are designed and implemented in a way that balances and mutually reinforces economic, environmental, and social objectives” (Europe Union Commission, Sustainable development Strategy, retrieved on 19.11.2006).

The Lisbon Special European Council 2000 (23 - 24 March 2000) policy was reviewed in 2005 and resulted in Commission of the European policy framework “Implementing the Community Lisbon Programme: A policy framework to strengthen EU manufacturing – toward more integrated approach for industrial policy”.

The aim of developed policy framework was to determine how to strengthen the manufacturing and construction industry. Detailed screening of competitiveness of manufacturing and construction industry sectors aimed to determine how performance of industry is or could be influenced by the instruments of industrial policy.

The most important competitiveness and policy challenges of basic and intermediate industries (which are energy-intensive and hence main

challenges are related to energy and environment) are “REACH legislation for the chemicals industry and legislative simplification issues for the construction sector” (Implementing the Community Lisbon Programme: A policy framework to strengthen EU manufacturing – toward a more integrated approach for industrial policy (2005)).

On the basis of the Industrial Policy, the Green Paper 2005 has been designed. The energy efficiency general scheme outlines that the energy efficiency policy is making a major contribution to the EU competitiveness and employment. These are the central objectives of the Lisbon agenda. Energy efficiency policy is a part of the EU policies on energy supply, including its efforts to promote renewable energies.

The Green Paper 2005 “aims at identifying options and opening a wide-ranging discussion on how to realise the cost-effective savings and to start the process towards rapid establishment of a concrete Action Plan, involving action on community, national, regional, local, and international levels and on the level of industry and of individual consumers to harness the identified potential energy efficiency savings”. The Green Paper 2005 identifies obstacles, which prevent implementation of energy efficiency and their cost-effectiveness, and options of how to overcome those obstacles.

The European Initiative is designing political and market instruments to mobilise all energy area players – governments, national regulators, large enterprises, local authorities, etc., and transform energy efficiency policy in the long-term. There are distinguished actions at the Community and National levels. At the Community level, there is a specific policy related to buildings.

Energy efficiency in buildings is an area where important savings can be made. The implementation of the Directive on the Energy Performance of Buildings (2002/91/EC) starting 2006 will permit the gaining of significant energy savings. For application of the Directive and establishing a framework for determining the energy performance of buildings, around 30 European (CEN) voluntary standards have been developed.

The Directive requires (Article 7) an energy performance certification of buildings. The certificates must be accompanied by recommendations for the cost-effective improvement of the building’s energy performance.

The Green Paper 2005 indicates the importance of effective lighting and provides suggestions how to use existing tools, such as Eco-labels and EMAS for enhancing energy efficiency. Under EMAS, energy efficiency is a part of continuous improvement and has to be addressed in the environmental review and the environmental statements to be performed under the scheme.

In Lisbon, February 2005, a new European Commission industrial policy “with a strong focus on addressing issues at sector-specific levels” was published
(http://ec.europa.eu/enterprise/construction/compet/compcon_en.htm)
including a strategy for competitiveness and growth of the construction sector. “E-CORE strategies for Construction RTD identify the changes required in the sector in order to fully support the goals”. The strategy has been prepared by the European Council for Construction Research, Development & Innovation and the members include European contractor, engineer, architect and material producer associations, as well as construction institutes.

“Construction” is defined as all activities that “contribute to the creation, maintenance, and operation of built environment” (E-CORE). Sustainability and competitiveness share a common objective – output should be achieved with minimum use of material and human resources. Sustainability requires the most efficient use of natural materials and the least impact on the environment (E-CORE).

The aim of this strategy is “to maximise the contribution of construction and the built environment to sustainable development, through the direct contribution of construction to economics, social and environmental goals and the indirect impact of the built environment on the economic performance, social characteristics and quality of life of European communities”.

The top-level goals for construction are consistent with European aims and aspirations defining construction as a value-focused, socially-responsible, innovative, learning and valued industry.

Presently, construction is characterised as an industry with fragmented responsibilities, processes, and resources. Despite this fact, it is considered as highly regulated. In the market, there is a short-term, price-based competition and it requires a high labour intensity. At the same time, it suffers from a poor image. In construction, there is a lack of focus on the end user

and performance indicators. Construction accounts for a high resource consumption (a high energy and water usage; a small proportion of material recycling; it is a source of industrial waste; there is a lot of energy used for transportation) and several serious direct environmental impacts (pollution, disturbance, noise, dust, water run-off, gaseous emissions, traffic disruption, displacement of normal functions, potential loss of business and additional costs). It is criticized as slow in innovation and poor in communicating with other stakeholders.

According to general development strategies, the built environment should be constructed and operated in “ways consistent with the principles of sustainability”. Hence, sustainable development is concerned with the use of resources, environmental protection, employment practices, the stability, and profitability of firms and the quality of life in communities and thus there will be implications for all aspects of construction.

According to the E-CORE developed strategy, the industry transition can be supported from five perspectives:

1) Meeting environmental demands
   - Reducing resource consumption (improving thermal performance, control systems, efficient glazing, heating and lighting, localised power generation system, reuse of water, use of recycled and waste materials and industrial by-products, more durable components, improved techniques for removing pollutants, cheaper and safer means of underground construction);
   - Maximising the use of renewable energy (design impact on renewable energy exploitation; design and construction of surface areas for heat and power generation; optimisation of design and loads; development of electrical distribution);
   - Reducing the impact of construction operations (non-local issues construction techniques, use of non-mechanical methods, techniques for on-site processing and reuse of waste, improved planning, and logistics);
2) Meeting user requirements and aspirations

- Understanding and modelling performance (interaction between the user and the built environment);
- Creating performance indicators;
- Communicating performance (dialogue with users – visualisation tools, better operational information for more efficient use of building/infrastructure; facilitating upgrading and reuse);

3) Changing the construction process
   - Adoption of a Life Cycle Perspective in planning and project implementation;
   - Lean production (assessment of constructability which can be aided by 4D modelling; just-in-time delivery);
   - Industrialisation (building as a “product”, which can be refined and improved through direct application of operational feedback and customer reaction);
   - Integrated delivery (creation of structures of relationships founded on common aims, values and processes and extending to users; Information and Communication Technology);
4) Enhancing construction employment
   - Improving the work environment through mechanisation, new site equipment and by improving health and safety;
   - Enhancing the quality of work through individual and team development and better communication and training.
5) Exploiting materials and technology opportunities
   - Technological areas with the potential for impact on construction materials and products are nanotechnology, biotechnology, information and communication technologies, and the use of natural and traditional materials;
   - Opportunities to the above-mentioned are separation and control; durability of structure and materials; flexibility and reuse, and intelligence and responsiveness;

The above-mentioned perspectives outline the core issues, which may contribute to a more sustainable construction industry.

Construction cannot be considered as an isolated process. The process itself and the result – the built environment - is creating spaces for social life and processes and influences the natural environment. The interests and rights of society are fostered by legal acts. A construction company on the one hand is subject to legislation and on the other hand has the potential to influence the focus of legal requirements. According to management theories, continuity of business development can be achieved be selecting strategic targets and determined strategies how to reach them. The target and therefore the strategy cannot be against the law and based on criminal activities. Therefore, it is logical that by selecting development targets and creating a strategy, the company management considers global and local legislation and market trends. In the particular case, it is suggested to build the construction company’s strategy on the above-mentioned construction industry transition necessary perspectives.

The transition will be supported by the 2-Level Matrix described in this thesis. As it was described previously, the 1st phase of the Matrix covers strategic decisions regarding a project development concept, location, and purpose. These decisions are based on considerations regarding the general framework of design, material class, and location alternatives. Aspects from the 1st phase corresponding to the 1st perspective – meeting environmental demands; the 3rd perspective – changing construction process and the 5th perspective – exploiting materials and technology opportunities shall be included in the strategy. Perspective 2 and 4 (i.e., meeting user requirements and aspiration; enhancing construction employment) is reaching beyond the strategic level. In order to adapt the operational mission and vision of a company in transition, relevant core principles shall be determined. Therefore, the core aspects, which should be considered in the strategy, are the following: resource and material consumption; waste management; releases to the water and environmental accident management. These aspects are interrelated and mainly linked to decisions regarding resource and material consumption. The waste amount and type is significantly changing depending on the selected materials and consumed resources. The chemical composition and quality of the material influences the volume and polluting character of emissions to water. Therefore, the frequency and significance of

environmental accidents will be influenced as well. It can be concluded that resources and material consumption frames the company’s environmental, quality, and financial performance.

A logical continuation of the strategy development will be planning at the operational level, where the second phase of the 2-Level Matrix may be used. At this level, each strategic issue should be described in detail and particular indicators should be used. The link between 2-Level Matrix and Strategy during the implementation process allows controlling whether both the strategy and the selected aspects and impacts are relevant. It prevents from conceptual mistakes and failures.

The above-mentioned decisions are closely linked to other issues of the Total Management System. Significant environmental aspects and selected indicators can be described from the financial, quality and social perspectives as well.

6 DISCUSSION

The initial idea of the Thesis was to formulate principles for implementation of an Integrated Management System tailored to the construction industry, which is covering all components of sustainability. The intention was to analyze the existing financial, environmental, quality, and social management systems and determine their sustainability, as well as strengths and weaknesses. Based on the analysis and evaluated best practices of other enterprises, guidelines for the Integrated Management System could be prepared. After the initial study of available management systems, conceptual findings, and the needs of a construction company, the scope of the research question was reduced and focused on the environmental management system.

Finally, it was decided to focus the Thesis on a conceptual approach to environmental aspect and impact identification in environmental management. The approach should be sustainable, comprehensive, within frames of legislation and “open” for integration in a company’s management system. In order to avoid “dead-end” decisions and misconceptions, the Strategic sustainable development model (Robe`rt and Schmidt-Bleek, 2002) was selected as the theoretical framework.

The result of the study is the 2-Level Matrix, which serves as the base for environmental aspect and relevant indicator identification and suggestions for an Environmental Management Strategy. The Matrix was developed by taking into account critiques made toward ISO 14001 according to Robe`rt and Schmidt-Bleek (2002) model and relevant suggestions for improvements. Recommendations for the Environmental Management Strategy were made with respect to the global trends and EU policy regarding the construction industry development.

Application of the 2-Level Matrix requires analysis of the company’s activities, involved parties, and sources of environmental pressures. Looking at the same aspect from different points of view allows recognizing actual impacts of actions and making decisions how to mitigate or prevent it. There is a risk that the analysis is made superficially and the consumed time is wasted. It is preventable by setting such targets of analysis that require answers to

critical questions. The ranking of different aspects’ significance still allows improvements and modifications. Translation of aspects to impacts was made using criteria, such as the EU strategies and European Construction Research Network findings. For tracking environmental baseline and perform auditing groups of indicators were selected. It would be desirable to specify indicators in more detail in order to facilitate the 2-Level Matrix application. The identified aspects and selected indicators are representing those issues sensible to the construction industry, which are in the agenda of politicians and industry experts.

The thesis has a rather practical approach and the 2-Level Matrix can be applied while establishing the Environmental Management System that can be integrated into the Total Management System. It is open to modification by including other aspects that are important for the company. In order to achieve the target, identification of principles for sustainable integrated management system in the construction industry, further study of financial, environmental, quality, and social management systems is needed. The basic principles of this Thesis could be considered as a good starting point.

7 CONCLUSIONS

The aim of the Thesis was to establish a conceptual approach to environmental aspect and indicator identification and make strategic suggestions for implementation of an integrated Environmental Management System in a Latvian construction company.

Although Environmental Management Systems like ISO 14001:2004 and Eco-Management and Audit Scheme are most frequently used and have challenging objectives, there is reason for criticism regarding fundamental elements of the System.

In the Latvian construction industry, there was no market demand for ISO or similar certification systems up to the year 2000. Most of the construction companies were, however, ISO and OHAS certified in 2004. The main reason to this rapid certification was market demands.

As a theoretical framework for evaluating and planning the EMS, the Robe`rt and Schmidt-Bleek (2002) strategic sustainable development model was used. It is a comprehensive sustainable planning approach that relies on continual consideration of the broader system in which specific actions are embedded. Within the scope of the model and other authors’ findings, several ISO 14001 drawbacks were recognized. The Standard has managerial nature but not “performance”, therefore it has been recognized that ISO itself does not ensure better environmental and economic performance. It is hard to ensure continuous development and perform the root-cause analysis on every significant aspect if the decisions are made based on ISO 14001. For ISO certification, it is not positioned as certification pre-requisite. Failure to identify a rigorous environmental baseline is misleading the sustainable development process. ISO 14001 does not require clear definition of the objectives and targets.

Suggestions were made to prevent the ISO 14001 drawbacks. Based on the discussed critique and suggestions, the 2-Level Matrix was developed. The matrix serves as an environmental aspect identification and relevant indicator selection tool. The matrix allows the introduction of aspect ranking and provides support for the decision-making process. During establishment of the matrix, experts from the company “A” were involved. Involving experts

helped to recognize weaknesses of the 2-Level Matrix and perform improvements. During several site visits, the matrix was tested and additional information obtained.

The core aspects, which were determined as significant using the 2-Level Matrix and suggested for the strategy, are the following: resource and material consumption; waste management; emissions to water and environmental accident management. Relevant groups of indicators are the following: energy performance of buildings; input material and waste balance; consumed and discharged water balance; and environmental accident impact.

To determine the global and long-term development plans and relevant legislative acts, which will frame activities of the construction industry, the European Union Strategy for Sustainable development (2001), the Lisbon Industrial Policy (2005), the Green Paper (2005), and the European Construction Research Network (2005) general guidelines were used. Based on the experience obtained from matrix development and experiments with it in a construction company, suggestions for an improved Environmental Management System for the construction industry could be presented.

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APPENDICES

Appendix 1: 2 level Matrix 1st level

Appendix 2: 2 level Matrix 2nd level

Rancing scale	1	2	3

No	Process phase	Sources of Environmental issues and pressures	Interested parties and stakeholders	Input		Output							Indirect environmental aspects	Ranking score		
				Direct environmental aspects	Indirect environmental aspects	Direct environmental aspects										
				1	3	2	1	1	3	3	2	1	2			
				Use of natural resources, materials and energy)	Indirect environmental aspects	Emissions to air	Releases to water	Solid, hazardous, construction and other wastes	Local issues (noise, vibrations, odour, dust, visual appearance, etc.)	Landscape	Ecological	Risk of environmental accidents and impacts	Indirect environmental aspects			
1	**Development idea**															
		Global environmental issues	Government	(2) Efficient use of energy and materials	(6) Construction material market development; planning ideology	(4) Restrictions on emissions	(2) Restrictions for national legislation	(1) Restrictions for national legislation	(9) Reduction and mitigation of all adverse aspects	(9) Sustainable development of surrounding	(2) Saving biodiversity	(1) Reduction of environmental risks	(4) Planning decisions	**40,00**		**8**
		Political responses to environmental issues	Government	(1) Quality demands for materials and process	(6) Capital investment, energy policy; planning decisions/ restrictions	(4) Green-house gas emissions (result of building operation) control - great level of concern; Protected areas and construction intensiveness	(1) River basin, sea, ground water pollution regulations - great level of concern	(1) Collection, disposal and recycling requirements	(9) General restrictions	(9) Legislative requirements regarding protected areas and planning acts	(2) Great level of concern and relevant legislation requirements	(1) Great level of concern and relevant legislation requirements	(2) Capital investment, granting loans and insurance services; energy policy	**36,00**		**6**
		Social reaction to the environment	Cultural heritage protection board	(1)Legal use of natural resources; Concerns about effects on heritage objects	(6) Effect on protected areas; new/ reduced protected areas; loss of significant archaeological resources	(4) Emitted gas effect on protected objects; Concerns about effects on heritage objects; archeologically significant areas	(3) No significant concerns	(1) Collection and disposal requirements	(3) Concerns about effects on heritage objects	(6) Legislative requirements regarding protected objects	(6) Saving biodiversity; loss of grazing areas	(2) Possible effect of acctident to protected object	(4) Capital investment; planning decisions	36,00	**30,00**	**3**
			Neighbourhoods	(1) Restrictions about natural resource yield; Effect on surrounding	(3) Increasing anthropogenic load	(4) Own health, live quality concerns,- great level of concern; Effect on current land use; social environment	(1)River basin, sea, ground water pollution; wastewater quality - great level of concern	(1) Collection, disposal and recycling requirements	(3) Great level of concern about future noise, vibrations, odour, dust, social environment	(3) Great level of concern regarding visual impacts	(4) Concern about land use disruption; Increasing anthropogenic load	(1) Great level of concern	(2) Effect on living environment quality; C2O from traffic using created infrastructure; loss of public recreational area	23,00		
			Potential inhabitants	(2) Restrictions about natural resource yield, legal use of natural resources	(3) Increasing anthropogenic load	(6) Affect on surrounding	(2) Regognized as important but lack of specific knowledge; Increasing anthropogenic load	(1) Increasing anthropogenic load	(9) Affect on surrounding	(3) Very important precondition	(2) Good living environment	(1) safety	(2) Living environment change; Increasing anthropogenic load	31,00		
		Technical advances and scientific discovery	Company's management	(1) More efficient use of energy, natural resources, materials (incl. recyclable materials)	(3) Changes in energy and material demand	(4) Heating solutions, adequate design to environment	(2) Unknown reactions, durability for materials; construction technology; wastw water manaement	(1) Waste and material type and volume; waste manegement	(6) New construction and mitigation methods	(9) Possibility to preserve valuable landscapes	(4) Technlogy to seve biodiversity	(1) Design solutions, safe materials, methods and equipment	(6) Long-term unforeseen effect due to new materials, approaches	37,00		**7**
		Economic influences	Company's management	(1) Power, water etc. communication establishment; material transportation; logistic network establishment	(3) Administrative and planning decisions; Investments	(4) Restrictions on emissions	(1) River basin, see, ground water pollution; wastewater quality - great level of concern	(2) Collection, disposal and recycling requirements	(9) General requirements	(9) Legislative requirements and planning acts	(2) Great level of concern and relevant legislation requirements	(1) Great level of concern and relevant legislation requirements	(2) Effect on living environment; social - economic development; panning decisions	34,00		**5**
		Legal liability	Municipality	(2) Restrictions about natural resource yield, legal use of natural resources; Power, water etc. communication establishment; construction density	(3) Requirements for used materials; consequences of incidents, accidents and emergency situations	(4) Emissions of green-house and other hazardous gases - great level of concern	(1) River basin, see, ground water pollution; drinking water quality; water habitat biodiversity - great level of concern	(1) Collection, disposal and recycling requirements	(6) General requirements about future noise, vibrations, odour, dust, social environment	(6) Legislative requirements and planning acts	(4) Land use changes, biodiversity endanger, destruction of natural habitat types and species concerned	(1) Great level of concern and relevant legislation requirements	(4) Capital investments, employment	31,00	**29,00**	**2**
			Environmental board	(1) Restrictions about natural resource yield, Legal use of natural resources; Material transportation load; power, water etc. communication establishment	(3) Consequences of incidents, accidents and emergency situations; Changes in water flow and flooding	(4) Following restrictions about emissions	(1) Following restrictions about wastewater quality - significant level of concern	(1) Collection, collection method, disposal and recycling requirements	(6) Compliance with requirements	(6) Planning acts	(4) Meeting legislation requirements	(1) Great level of concern and relevant legislation requirements	(2) Acid rains; ground and surface water flow and direction; Changes in water flow and flooding; wastewater volume increase and chemical compound change	29,00		
			Company's management	(1) Restrictions about natural resource yield, legal use of natural resources	(3) Design, material, technology innovations	(4) Legal compliance when choosing heating solutions, logistics	(1) Legal liability for quality and quanitity	(1) Legal liability for type and volume	(9) Employers and neighbour protection	(3) Planning aspects	(2) Aware and concerned	(1) Greate level of concern about consequences	(2) Capital investments, employment; legal equirements	27,00		
		Financial performance	Company's management	(1) Costs of material, energy, services provision	(9) Short life-cycle constructions	(4) Keeping high level of attention	(1) Costs of safe construction	(1) Collection, disposal and recycling requirements	(3) Result of good management	(3) Planning acts	(4) Meeting legislation requirements	(1) To limit possible loses; costs of insurance	(4) Durability and warranty	**31,00**		**4**
		Market forces	Competitors	(2) Used approaches	(9) Changes in service provision methods	(4) Effect on own plan - significant concerns	(1) Requirements regarding wastewater quality	(1) Effect on own project	(9) Effect on own project	(9) Planning acts; Effect on own project	(6) Not developed jet	(3) Concerned about consequences	(6) Loss of public recreational area	50,00	**40,33**	**8**
			Service providers (water, gas, power)	(1) Some requirements regarding possible connections for provision and discharge; Possible connections to services (water, energy, fuel, gas)	(3) Consequences of incidents, accidents and emergency situations	(4) Following restrictions about emissions	(1) Following restrictions about wastewater quality - significant level of concern	(1) Meeting collection requirements, collection method, disposal and recycling requirements	(9) Compliance with requirements	(9) Following planning acts	(6) Meeting legislation requirements and chose of most environmentally friendly approach	(1) Great level of concern and relevant legislation requirements	(4) Major changes in client behaviour	37,00		
			Potential inhabitants	(4) Restrictions about natural resource yield, legal use of natural resources; Available services (water, energy, fuel, gas)	(9) Changes in consumer preferences	(2) Effect on living conditions; Accessibility - traffic connections, communications; service provision	(2) Important for clean and save environment	(2) Important for clean and save environment	(9) Affect on surrounding	(3) Very important precondition	(2) Living quality but no tools	(1) Very concerned about consequences	(2) Increased C_2O emission; change in biodiversity	34,00		
		Corporate values and aspirations	Company's management	(1) Locally available materials, energy resources, labour; energy efficient solutions, services and material use	(9) Develop good living environment	(2) Good location and living environment	(1) Safe construction and good living environment	(1) Safe construction and good living environment	(3) Good working environment	(3) Respecting nature, culture and living environment	(4) Respecting nature, culture and living environments	(1) Environmental damage prevented through risk management	(2) Adverse effect on water flow, flora, fauna	**27,00**		**1**

Ranking score	20,00	78,00	54,00	21,00	17,00	102,00	87,00	54,00	17,00	46,00
Significance level (1 most significant)	3	6	5	2	1	8	7	5	1	4

1 Phase: Development idea 2 Phase: Design and Construction		Environmental Aspects									
		Use of natural resources and raw materials (including energy)	Indirect environmental aspects	Emissions to air	Releases to water	Solid, hazardous and other wastes	Landscape	Risk of environmental accidents and impacts	Ecological	Local issues (noise, vibrations, odour, dust, visual appearance, etc.)	Indirect environmental aspects
Group of indicators	Energy performance of buildings										
	Input material and waste balance										
	Endangered water source and water saving balance										
	Environmental impact and used renewable resource balance										

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