

ACTA

Pekka Tervonen

INTEGRATED ESSQ MANAGEMENT

AS A PART OF EXCELLENT OPERATIONAL AND
BUSINESS MANAGEMENT—
A FRAMEWORK, INTEGRATION AND MATURITY

FACULTY OF TECHNOLOGY,
DEPARTMENT OF INDUSTRIAL ENGINEERING AND MANAGEMENT,
UNIVERSITY OF OULU



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PEKKA TERVONEN

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Abstract

When examining management from the viewpoint of systems approach, the main elements are the overall management systems of a company and the related ESSQ matters and other critical success factors, depending on their theme. Excellent business management e.g. by taking advantage of quality award models is also becoming one of the cornerstones of the success of an organisation. Companies increasingly need more efficient and productive systems to maintain their competitiveness. These kinds of systems should continuously improve the company's operations and increase the satisfaction of customers and other interest groups.

A qualitative approach is mainly applied in this dissertation. This dissertation is composed of five research papers, in which qualitative approach is also used. The empirical data of this dissertation were obtained through interviews and a questionnaire among experienced industrial managers. All individual interview results and replies to the questionnaire were analysed and, when appropriate, compared to the literature. Finally, conclusions and synthesis were drawn based on the analysis.

As a general conclusion, it can be stated that combining issues that fall under different themes is reasonable because, on one hand, the causes of problems may be common to all areas and, on the other hand, solving one separate problem may easily lead to problems in other fields of business. Business-orientedness can be further increased by taking maturity models into consideration. Organisations, which apply holistic management systems that take all essential success factors of business into consideration, approach the natural functioning of an organisation. The integration of different operational areas into one system will facilitate the management of operations, increase internal co-operation and save resources, time and costs.

The starting point of holistic management is that needs can be fully addressed only when all relevant variables of the entire organisational system are taken into consideration. Systematically integrated management systems that cover different operating models in an extensive manner and that function well are not yet common, but there is a clear trend towards the integration of different systems. This dissertation indicates that the ultimate purpose and genuine contribution to business of Integrated ESSQ Management and maturity models is to provide a framework, which helps companies to better understand and incorporate these issues as a part of their overall Operational and Business Management. In principle, every company should develop its own management model that is tailored to meet the needs of the organisation in question.

Keywords: environmental management, integrated ESSQ management, management maturity models, quality management, safety and security management

Nelli, Neetta, Santtu and Sarianna

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Kempele, May 2010

Pekka Tervonen

List of abbreviations and definitions

BE	Business Excellence
BM	Benchmarking
BS	British Standards
COBIT	Control Objectives for Information and related Technology
CMMI	Capability Maturity Model Integration
CSRMS	Community and Society Relationship Management System
E	Environment
EFQM	European Foundation of Quality Management
EHSQ	Environment, Health, Safety, Quality
EM	Environmental Management
EMAS	Eco-Management and Audit Scheme
EMS	Environmental Management System
ESSQ	Environment, Safety, Security, Quality
FMS	Financial Administration System
I	Inspection
ILO	International Labour Organization
ILO-OHS	International Labour Organisation – Occupational Health and Safety
IMS	Integrated Mangement System
IPD-CMM	Integrated Product Development Capability Maturity Model
ISO	International Organization for Standardization
ISRS	International Safety Rating System
MBNQA	Malcom Baldrige National Quality Award
MET	Technology Industries
NADCAP	National Aerospace and Defense Contractors Accreditation Program
OHSAS	Occupational Health and Safety Assessment Series
OHSMS	Occupational Health and Safety Management System
OPEX	Operational Business Excellence
PART	Program Assessment Rating Tool
PDCA	Plan Do Check Act
Q	Quality
QA	Quality Assurance
QC	Quality Control
QM	Quality Management
QMS	Quality Management System
RQ	Research question

SCC	Safety Checklist for Contractors
SEI	Software Engineering Institute
SFS	Finnish Standards Association
SPC	Statistical Process Control
SS	Safety and Security
SSM	Safety and Security Management
SSMS	Safety and Security Management System
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TQM	Total Quality Management

List of original publications

This dissertation is based on the following publications:

- I Tervonen P, Haapasalo H & Juntunen S (2010) Development of environmental management: a case study of steel production. *International Journal of Sustainable Economy* 2(2): 144–163.
- II Tervonen P, Haapasalo H & Niemelä M (2009) Evolution of safety management and systems in a steel production organization. *The Open Management Journal* 2(11): 17–27.
- III Tervonen P, Pahkala N & Haapasalo H (2008) Critical incidents in the development of quality management in steel manufacturer' production. *International Journal of Business Excellence* 1(½): 106–120.
- IV Tervonen P, Alapiha J & Haapasalo H (2009) Benchmarking ESSQ management system through tailored maturity model. *International Journal of Management and Enterprise Development* 7(3): 262–280.
- V Tervonen P, Haapasalo H & Pääkkilä J (2010) The integration of ESSQ management and quality award models in leading international steel companies. *International Journal of Innovation and Learning* 8(1): 58–77.

All five original articles have been published in international professional journals. The author of this dissertation has been the primary author in all of the original publications. The researcher has been responsible for formulating the research problems, collecting theoretical base, formulating research questions, coordinating and also participated the collection of empirical material, analysing the material, drawing conclusions, and finally being the primary author for all the five articles. The role of co-authors has included collecting of empirical material and reviewing and commenting the article manuscripts of the first author.

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1 Introduction

1.1 Background and research environment

Organisations need to constantly improve their operations, competitiveness and efficiency. For this reason, there is also a need for systems thinking. Different management systems function as frameworks and a way to operate, in addition to which they support continuous improvement. There is no general, all-inclusive management system, which means that the integration process must be based on the objectives of each organisation: what the organisation in question aims to integrate, manage, control and obtain. (Wilkinson & Dale 2000)

A management system is an organised group of components, which help an organisation to meet one or several goals set. The goals set may be, for example, decreasing environmental impacts, minimising the number of accidents and incidents or overall improvement of quality. The most important goal of all management systems is, at the end of the day, to decrease chaos in all operations of the organisation. Environmental, safety and security and quality problems often originate from the same reason, and therefore they should be addressed using one and the same system. Focussing on quality problems only will inevitably cause problems in the field of safety and the environment. (see e.g. Dennis 1997)

System thinking has, during the last decade, evolved into an important management tool. Environmental, safety, quality and other operating systems, in particular systems based on standards, function as building blocks of a company. In order to eliminate overlapping operations and structures, these separate management systems have been integrated into all-inclusive corporate management systems that would cover all operations of a company. Integrated management systems are a tool towards excellent business management. (see e.g. Wilkinson & Dale 1999, Voutilainen *et. al* 2001, Jørgensen *et al.* 2006, EFQM 2007, Zeng *et al.* 2007)

Environmental management has become an important part of everyday operations of companies, which can be seen in the establishment and increasing use of environmental management tools and procedures. A number of studies state that companies should integrate sustainability into their core business values and strategies using integrated management systems, because this is the best way to obtain sustainability (see e.g. Kallio 2001, Kolk & Mauser 2002, Johnson & Walck 2004). Singh *et al.* (2008) describes the current environmental strategies of

the steel industry as being dynamic and depending mainly on the interests of various stakeholders. Today, companies can no longer ignore the management of environmental issues, thanks to the rapidly developing environmental legislation, international certified standards, and increasing requirements by the customers (see e.g. Rice 2003, Johnson & Walck 2004). In addition, there is a great public concern about the environment, in particular due to climate change. As a result, emission trading has been commenced, which significantly affects the steel industry (Heiskanen 2004).

Safety can be defined as a state or status of a system where all business-related risks are at an acceptable level (Simola 2005). Corporate safety means the overall management of all safety issues of an organisation (Kerko 2001). There is no separate management model for corporate safety and, until now, every category has been developed as a separate unit. The importance of risk management is constantly emphasised in companies and the importance of overall safety to the profitability, business and competitiveness of a company is significant. Corporate safety management is partly required by legislation but it is also a way to gain competitive advantage. The leading international companies have increasingly invested in different safety sectors: and safety is considered an essential precondition of competitiveness, and an integral part of high-quality business operations. (see e.g. Miettinen 2002, Laatunen 2005, Naumanen & Rouhiainen 2006, Leppänen 2006, Lanne 2007). Transparency and open communication with respect to safety issues are expected of companies and both media and customers show particular interest in industries with a high safety risk level. Increasing attention is also being paid to safety level when mapping possible co-operation partners. (Laatunen 2005, Simola 2005) The development of an internal safety culture is one of the most important factors when striving for successful safety management of a corporation (Choudhry & Mohamed 2007). Instead of being a separate business feature, safety should be a natural part of everyday routines (see e.g. Hill & Smith 1995, Mottel *et al.* 1995, Hansen 2006).

The pursuit of excellence and continuous improvement of business competitiveness are central objectives of quality management. A company's expertise must be up-to-date, although it must be noted that the expertise level will inevitably rise through quality management, if quality work is appropriately carried out. Total Quality Management (TQM) means the total development of all operations of a company aiming to achieve higher customer satisfaction and more profitable business. The long-term goal is to maintain and improve competitiveness (Silen 1998). Quality as a concept is multifaceted and relative

and it can often be arduous to perceive. It is not possible to form a correct, profound understanding if one merely examines quality from one perspective only (Lillrank 1998). The success of TQM seems to depend critically on the commitment of the executive level, transparent organisation and employee empowerment. It also mirrors the necessity to develop a supporting atmosphere and culture to further improve the performance outcomes of TQM implementation. (Joyner 2007)

The word integration is often considered to refer to the joining of individual components into one whole. Different organisations have significantly different viewpoints on integration and integrated management systems. For example, at the moment, there is no widely accepted standard for integrated management systems that would correspond to the ISO standards, perhaps due to the different integration levels in organisations, which pose a challenge for a single universal standard. (Jørgensen *et al.* 2006) The most commonly used integrated management systems are environmental, occupational health and safety, and quality. There is no common, universal integrated management system, but integration must originate from the objectives and aspirations of the organisation in question. The organisational culture and atmosphere must support the goals of integration and the work towards the combination of different management systems. Otherwise integration is restricted to the mere integration of documentation. (Wilkinson & Dale 2000) Jørgensen *et al.* (2006) also describe the case-by-case nature of integration: there is no one specific way to integrate management systems, but integration must be in line with the operations of the organisation.

The greatest advantage of integration is the opportunity to decrease the number of overlapping systems. Decreased documentation, registration, bureaucracy and paperwork will result in saving time and resources: the aforementioned processes are optimised and both internal and external audits will become less complex. An additional benefit is that targets and responsibilities for different integrated areas of operation are determined in one place and on the basis of one management system. (Jørgensen *et al.* 2006, Zeng *et al.* 2007) According Jørgensen *et al.* (2006) and Zeng *et al.* (2007), change must penetrate all levels of the whole organisation. It must not remain a mere nominal change within an organisation and integration of operations.

There is also an alternative to the integration of management systems: different management systems can be left as they are, as separate systems within an organisation. In this case, conflicts will create between different systems, in

addition to which they have overlapping operations. The organisation will face additional costs, unnecessary bureaucracy, and more documentation. The likelihood of errors and defects also increase significantly, and overlapping tasks will emerge. (see e.g. Beckmerhagen *et al.* 2003) The strongest force against integration is usually the inability of the senior management to commit to the integration process, their lack of knowledge or the challenging nature of the integration process. (see e.g. Wilkinson & Dale 2001, Conti 2006, Zeng *et al.* 2007).

Earlier studies show that using maturity models is also advantageous for companies (see e.g. Conti 1997, Saizarbitoria 2006, Bou-Llusar *et al.* 2008). The most popular model is the EFQM, which also suits well in different areas. The EFQM model examines the operations and procedures of organisations from the viewpoint of business. The Toddler model is a maturity model specifically developed for the ESSQ management of organisations, which can use the model to evaluate and develop the ESSQ operations of their processes or the whole organisation (Tervonen *et al.* 2008). The Toddler model assesses the maturity of an organisation always with respect to risk and operating environment.

The international financial crises and economic downturn that commenced at the end of 2008 hit the customers of the steel industry hard, which resulted in a plummeting demand in the entire industry. The steel industry rapidly responded to the changing situation by adjusting its operations around the world to match the decreasing demand. It is difficult to forecast how long the economic downturn will last, which further increases the pressure on steel operators to streamline their operations and ensure good long-term profitability. The change in the operating model in the case company and the consequent change in the position of business locations created the need to study ESSQ management as a part of business management. There was a clear need to better understand ESSQ management as a part of business management and the related integration of management systems, use of maturity models and the consequent benefits and challenges. Putting emphasis on continuous learning and learning faster than competitors in particular – a good example of which is the better understanding and application of integrated ESSQ management and maturity models in business management – are considered competitive advantages.

1.2 Objectives and scope of research

The components of ESSQ management, namely environment (E), safety and security (SS) and quality (Q) are becoming increasingly important targets of development, in particular when facing global competition. Environmental management refers to the management of environmental issues related to the company's operations in such a way that environmental management is considered as a sector of corporate management and a part of the company's strategy. It also refers to the management of the environmental impacts caused by the company's business operations in such a way that the impacts match the objectives set. Safety management includes safety and security is the part of a company's operations that ensures the prevention of accidents and minimises the losses caused by accidents. The starting point of quality management is that things are done in the right way at the first time. Quality management is seen as all-inclusive development of all business operations of a company in order to achieve greater customer satisfaction and profitability of business.

The development of management systems and integrating ESSQ issues in one system will enable better competitiveness. The objective of management systems is to support the strategic and operative management of a company. It is vital for the efficiency of management systems that they are linked with the company's strategy and operating culture. The most commonly integrated management systems are related to the environment, occupational health and safety and quality. These systems are often based on the widely used standards ISO 14001, OHSAS 18001 and ISO 9001, which contain common characteristics and principles, which make them relatively easy to combine. (Wilkinson & Dale 1999, Jørgensen *et al.* 2006, Zeng *et al.* 2007)

According to the Zeng *et al.* (2005) study in the construction industry in China, the most important reason to integrate e.g. the ISO 14001 and ISO 9001 series of standards was their similarity and compatibility. The two series are so similar that managing them separately makes it more difficult for the company to improve its management processes and meet its business goals. Another reason to integrate the two series was their mutual compatibility. This means that when the standards are implemented, the elements included in them can be combined. This way, overlapping operations can be avoided. Recognising the similarity of different components and harmonising them in a sensible way will, according to Jørgensen *et al.* (2006), bring the following advantages to an organisation: minimising documentation and records, decreasing bureaucracy, less paperwork,

decrease in costs and resources needed, and simplification of both internal and external audits.

It is no longer sufficient for an organisation to only consider internal matters inside its own walls; instead, the surrounding community, customers and an increasingly diverse range of interest groups must be taken into account in corporate management systems. Excellent business management e.g. using quality awards is also becoming one of the cornerstones of a successful organisation.

Quality is the component of ESSQ management that has the longest traditions in terms of research. Extensive research has also been focussed on environmental and occupational safety management during the last two decades. Research in corporate safety commenced as recently as in the 2000's and it is in its early stages. There has been increasing academic interest in systems thinking in the 2000's. So far, there has been little research in integrated ESSQ management and the related aspects and hardly any research incorporating maturity models in the study of integrated ESSQ systems.

Theoretical foundation of this dissertation is based on the integration of the environmental, safety and security, and quality management. The integrated ESSQ management system acts as the framework for this dissertation. The main objectives is clarify approach, framework, benefits and challenges of the integrated ESSQ management system and the utilization of the maturity models especially EFQM model. The research problem of this dissertation is as stated hereunder:

There is a lack of knowledge on effectively integrating a management system in the areas of Environment, Safety & Security and Quality into a company

There are a number of different approaches to this research problem. In this dissertation, the research problem was studied from five mutually complementary perspectives, which were formulated into five research questions (1–5 RQ) as indicated in Table 1 and which form the framework for compiling the research findings.

Table 1. Research questions.

RQ	Title
1	What are the general and case centred EM development paths and contribution to the case company OPEX and BE?
2	What are the general and case centred SSM development paths and contribution to the case company OPEX and BE?
3	What are the general and case centred QM development paths and contribution to the case company OPEX and BE?
4	What are the framework, benefits and challenges of integrated ESSQ management system versus BM companies?
5	What are the benefits and challenges of ESSQ integration and utilization of EFQM model versus BM companies?

The research problem is divided into five interrelated research questions with different aspects as describe in the previous chapter. In this dissertation, each research question is answered in more detail by means of a journal article. Each article provides a partial solution to the research problem. The essential contributions of these articles are summarised in the dissertation summary. This dissertation combines the contributions of the articles in order to propose a solution to the original research problem.

This dissertation is a compilation of five original publications and the summary. All five original publications have been published in international professional journals. I have been the primary author of all original publications. In case of articles in co-operation with other authors, I ensured the novelty of contributions and incorporated them in order to give additional value to this research as a whole and to the research environment. Table 2 lists the journal articles and combines them with the research questions.

Table 2. Research articles overview.

Article	RQ	Title	Publication
I	1	Development of environmental management: a case study of steel production	International Journal of Sustainable Economy
II	2	Evolution of safety management and systems in steel production organization	The Open Management Journal
III	3	Critical incidents in the development of quality management in steel manufacturers' production	International Journal of Business Excellence
IV	4	Benchmarking ESSQ management system through tailored maturity model	International Journal of Management and Enterprise Development
V	5	The integration of ESSQ management and quality award models in leading international steel companies	International Journal of Innovation and Learning

The research questions are interrelated even though their focus is different. Figure 1 depicts the scope of the dissertation – the individual research questions and areas are illustrated with a triangle. The research subjects were chosen in order to better understand the nature of the operating area as a whole. The research perspectives were chosen at the very beginning of the research process. The main research areas remained the same during the whole research, but the research questions have been refined as the research progressed.

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a framework, integration and maturity

Article = RQ	Contents	Cover
Article V = RQ 5	ESSQ integration and EFQM	Benefits and challenges BM 2: leading international steel companies in ESSQ-issues
Article IV = RQ 4	Integrated ESSQ Management System	Framework, benefits and challenges BM 1: leading Finnish companies in ESSQ-issues
Article I = RQ 1, Article II = RQ 2, Article III = RQ 3 General and case centred EM, SSM, QM development and contribution to the case company OPEX and BE		

Fig. 1. Research framework and path.

Articles I–III discuss research questions RQ 1–3. The articles examine the development paths and frameworks of environmental, safety and quality management, in addition to the current view on successful environmental, safety and quality management with respect to business management. The separate examination of these areas of ESSQ management creates a foundation for the understanding of the integrated ESSQ management framework. Linking the study of the theoretical framework of ESSQ management with the respective empirical study of the case company supports the creation of future ESSQ management models of the case company, in particular. In addition, the results bring depth and foundation in the whole research in integrated ESSQ management.

Article IV discusses research question RQ 4. This article focuses on the framework of integrated management system, aspects related to the implementation of ESSQ integration and benefits and challenges of integrated systems. Linking the study of the theoretical framework of integrated ESSQ management with the respective empirical study of the case company using benchmarking supports the creation of ESSQ Operational and Business Excellence operating models in the case company, in particular. A simple Toddlergrade maturity model was developed for the assessment of the maturity level of integrated ESSQ management and development of operations. The results

bring depth and foundation in the whole research into integrated ESSQ management.

Article V discusses research question RQ 5. The article studies the benefits and challenges of the application of integrated ESSQ management systems and the EFQM model in particular from the viewpoint of organisational success. Linking the study of the theoretical framework of integrated ESSQ management with the respective empirical study of the case company using benchmarking supports the creation of ESSQ Operational and Business Excellence operating models in the case company, in particular. The Toddlergrade maturity model developed for the improvement of ESSQ management is applied in the article. The results bring depth and foundation in the whole research into integrated ESSQ management.

The research contribution summary of this dissertation is based on the consensus of the study results (articles I–V) and theoretical framework applied. The essential contributions of these articles are summarised in the summary of this dissertation. The connection between theoretical and empirical components of this dissertation is presented as the study triangle in Figure 1. The triangle creates a gradually progressing framework that is based on ESSQ theory, which also contains the link to a company's competitiveness and success established in earlier ESSQ studies. In the research triangle, the results of empirical study of the case company and benchmarking companies are linked with the ESSQ theoretical framework. The results are interpreted through the different ESSQ management areas, integrated management systems and theoretical frameworks of maturity models. In conclusion, this dissertation combines the contributions of the research papers to the original research problem.

1.3 Research approach

The nature of research data, the way it has been obtained and the method of processing it significantly affect research results. Consequently, a certain kind of data requires a specific method of obtaining information. This dissertation mainly takes the qualitative approach. However, this dissertation is composed of five research articles, in which the qualitative approach is also used.

The way data is retrieved can be divided in academic concepts. Olkkonen (1994) divides the methods between positivism and hermeneutics (Table 3). In positivism, the retrieval of information is based on noted and verifiable observations, and objective measures are used in processing observations. The

goal is to define phenomena in a quantifiable way and process them in numerical analysis, whereas the hermeneutic approach incorporated the understanding of the researcher and specialists in the field on connections between matters, underlying reasons for different phenomena and events. Observations and research results are mainly qualitative and they are processed on the basis of the researcher's interpretation. The objective is to obtain in-depth information on the objects of research and the study cases are often unique. (see e.g. Gray 2009)

Table 3. Research approaches (modified from Olkkonen 1994).

Positivism	Hermeneutics
Quantitative	Qualitative
Noted/verifiable observations	Connections between objects
Objective methods	Researcher's interpretation
Measurability	Cause-consequence relations
Statistical	Qualitative

It is, however, rare that every stage of a study is purely either positivistic or hermeneutic. The approach of this dissertation is mainly hermeneutic, which is characterised by complex structuration of the research problem (Table 4). The observations made during dissertation and the results derived thereof are mainly qualitative, which allows a more in-depth view on the issues and the discovery of unexpected matters. The objective of dissertation is to find in-depth information even though the number of cases studied is not always great. (see e.g. Olkkonen 1994)

Table 4. Hermeneutic research approach (modified from Olkkonen 1994, Järvinen & Järvinen 2000, Yin 2003).

The hermeneutic research approach	
Research problem	Complex structuration of the research problem
Processing research data	Case study
Collecting research data	Interviews, questionnaires, observations, study of documentation
Case methods	Narrative, tabling, explanatory, interpretative
Nature of a case study	Descriptive, testing a theory or creating a theory
Challenges	Universal applicability, non-statistical interpretation and repeatability

Division into different research methods is not – nor should it need to be – always clear. Different methods can be used in one research study, both statistical and qualitative analysis and both positivistic and hermeneutic approach. One can

statistically examine, for example the causes and consequences of phenomena, and try to interpret them using a more in-depth approach. (Alasuutari 1994, Olkkonen 1994, Creswell 2006, Bogdan & Biklen 2007, Edmonson & Irby 2008)

The most common hermeneutic data processing method is the case study. A case study focuses either on a single case or multiple cases. This dissertation is a multiple case study: the objects of research are the units of the case company and the benchmarking companies e.g. other Finnish companies and the selected member companies of the World Steel Association. Typical to a case study, research data was compiled using a number of methods: observation, questionnaires and study of documentation. In a case study, a single case is studied with respect to its environment. (Olkkonen 1994, Hirsjärvi *et al.* 1997)

A case study can be descriptive in nature, or it can test or create theory. (Järvinen & Järvinen 2000, Olkkonen 1994) When drawing conclusions and making generalisations multiple case studies should be considered as a piece of research consisting of several tests. Generalisations should be made in an analytical manner taking advantage of the existing theoretic framework, which must be made prior to carrying out the study in order to be able to collect appropriate empirical data. (Yin 2003)

This dissertation both applies existing theories and creates new theory. In qualitative research, theory is utilised in two ways: theory is a tool that helps to carry out research, whereas the objective of research is to further develop theory. In its first function as a tool, qualitative research needs to be supported by both background theory and interpretation theory. On one hand, research data is mirrored and evaluated against the background theory and, on the other hand, interpretation theory helps to define research questions and what kind of information is retrieved from research data. Theory can also be the goal of qualitative research. This is the case when inductive conclusions are drawn from the material, that is, when individual observations are used for making generalisations. In this case, the objective is to create new theoretical knowledge. (Eskola & Suoranta 1998)

Järvinen & Järvinen (2000) describe Cunningham's four intensive methods for carrying out a case study, which aims at establishing an intensive understanding of incidents related to a person, group or an organisation. In this dissertation, all methods stated hereunder are applied in the interpretation of replies to interviews and questionnaires. The result may be a history, description or interpretation of unique experiences and events. The researcher must utilise data representing different viewpoints and time perspectives. According to

Cunningham, intensive methods are narrative, tabling, explanatory and interpretative case methods:

- In the narrative method, descriptions are summaries of interviews. The categories used in descriptions are created on the basis of the sorted and classified material, which allows examining one object from a number of different viewpoints.
- Tabling refers to the tabling of the occurrence of different incidents. The researcher must define the categories whose prevalence is examined.
- The explanatory method is used when recording facts for drawing conclusions, This differs from tabling in that in this case the researcher merely produces information that supports the explanation.
- The interpretative case method provides descriptions or examples of new ideas or approaches and it is less specific and more provocative.

The challenges of this dissertation included the universal applicability of the research results and hermeneutic research based on proven facts, which is not part of positivism. The reliability of the results obtained from a case study is also compromised by the fact that case studies are difficult to reproduce. (Järvinen 2000) According to Yin (2003), these challenges can be met by means of detailed description and documentation of the research, among others. Different alternatives must be taken into account when interpreting the research data and a diverse range of viewpoints must be included. In addition, one must be careful when making generalisation. In this dissertation, particular care has been taken with respect to these issues.

1.4 Realisation of the research and structure of the dissertation

The empirical data of this dissertation was obtained through interviews and questionnaire among experienced industrial managers. These interviews and questionnaire formed the foundation for five articles. This material was then complemented by literature reviews. The researcher planned and organised the collection of the material and also participated in collecting research material. He was also responsible for analysing the material and drawing conclusions. The research process related to articles I–V is presented in Figure 2.

Literature review	Creating questions for in-depth surveys	Interviews and documentation in case company	Analysis	Conclusions
The first three articles (I-III).				
Articles I-III and literature review	Creating questions for in-depth surveys	Interviews in Finnish/International benchmarking companies	Analysis	Conclusions
The fourth article (IV).				
Articles I-IV and literature review	Creating questions for questionnaire studies	Questionnaire studies in international steel benchmarking companies	Analysis	Conclusions
The fifth article (V).				

Fig. 2. The research process of articles I-V.

The individual research processes of the articles are described in more detail in each article. Table 5 presents the number of interviews and questionnaires and the number of companies for each research article.

Table 5. Number of industrial interviews and questionnaires for each article.

Article	Title	Number of interviews	Number of companies
I	Development of environmental management: a case study of steel production	13	1 (4 works)
II	Evolution of safety management and systems in steel production organization	12	1 (4 works)
III	Critical incidents in the development of quality management in steel manufacturers' production	10	1 (4 works)
IV	Benchmarking ESSQ management system through tailored maturity model	4 1 workshop	4 2
V	The integration of ESSQ management and quality award models in leading international steel companies	7 questionnaires	7

The development of environmental, safety and quality management was first studied through the literature to create a solid foundation for the research. The first three articles take the historical framework and current views of environmental, safety and quality management as a business management tool into consideration. In the theoretical part of these articles, environmental, safety and security management their contribution to operational and business excellence were also discussed as concepts.

The empirical part of the study describes the history and current status of environmental (13), safety (12) and quality management (10) by means of 35 interviews that were carried out in a total of four units of the case company. The interviewees ranged from the highest management to production line supervisors and environmental, safety and quality managers. Interviews were carried out face-to-face, they were recorded and summarised afterwards. The approach of this study is qualitative and the study is descriptive in nature. (Olkkonen 1994)

The questions were mainly qualitative and they were based on the literature referred to in the theoretical section of this study. The questionnaire was also approved of by the representatives of the case company and the questions were e-mailed to informants before interviews so that they had the opportunity to reflect their answers. This was done in order to gain in-depth knowledge of their practices and methods. The questionnaire was divided into three parts. The first part aimed at describing the development of environmental, safety and quality management. The second part aimed at mapping the current state of environmental, safety and quality management in more detail. The objective of

the third part was to provide practical views on developing environmental, safety and quality management.

All individual interview results were analysed, and when appropriate, compared to the literature. The current status of environmental, safety and quality management was examined in more detail by means of SWOT analysis and maturity levels by CMMI maturity model, Silén's (1997) maturity model and Jokinen's (2004) Sea chart. Finally, conclusions were drawn based on the analysis.

The research process for the fourth article (Fig. 2) included first studying the relevant literature regarding integrated ESSQ management and maturity models for an adequate understanding of the studied issue. The empirical part of the study describes the ESSQ maturity levels by means of 4 interviewees carried out in 4 Finnish benchmarking companies and 1 workshop in 2 Finnish companies. The interviewees represent the personnel from the highest environmental, safety and quality management. Interviews were performed as personal face to face interviews, which were recorded and also summarised after interviews. The study approach is qualitative and the study is descriptive in nature. (Olkkonen 1994)

The questions were mainly qualitative in nature and they were based on the literature referred to in the theoretical section of this study. In addition, the questions used in benchmarking were based on the analysis and results of three articles in the case company's ESSQ management. Questions for benchmarking events e.g. interviews were specifically made for each company in such a way that the questions concerned the said company's strong ESSQ sector in order to be able to form a view of the best possible ESSQ management. The interview questions were divided into four categories according to the Toddlergrade maturity model, which the case company had prepared on the basis of the PDCA approach and the EFQM model: leadership, steering systems, follow-up systems and innovativeness. The questionnaire was also assessed by BM company representatives and e-mailed to informants before interviews, in order get profound knowledge from practice.

Companies were chosen for benchmarking because they can be considered to be both national and international leaders in environmental, safety and quality issues. All individual interview results were analysed, and when appropriate, compared to the literature. The Toddlergrade maturity model was applied as the maturity model for its four important characteristics: it is simple, transparent, it can be applied to companies of different sizes operating in different fields of industry, and it allows rapid assessment of a company. The Toddlergrade maturity model is utilised by the case company for the development of its ESSQ

management, and it can be used for assessing and developing the ESSQ operations of its processes or the whole organisation. Finally, conclusions were drawn based on the analysis.

The research process for the fifth article (Fig. 2) first included the study of the relevant literature regarding integrated ESSQ management and maturity models in order to ensure adequate understanding of the studied issue. The empirical part of the study describes ESSQ maturity levels by means of 7 benchmarking questionnaire surveys carried out in seven international steel companies that are considered world leaders in ESSQ issues. The recipients of the questionnaire were the representatives of the highest-level environmental, safety and quality management. The study approach is qualitative and the study is descriptive in nature. (Olkkonen 1994)

The survey sent to international steel companies was conducted as a written questionnaire. The questions were mainly qualitative, and they were based on the literature referred to in the theoretical section of this study. In addition, questions used in the benchmarking process were founded on the analyses and results presented in the three articles about the case company's ESSQ management, and on the fourth article on ESSQ management in Finnish companies. The series of questions used in the interviews of the ESSQ study was adjusted for this study. The questionnaire was divided into six parts. The first (Part A) examines the background of ESSQ management in the target organisation. The following four parts (B–E) focus on the maturity levels of different sections in accordance with the Toddlergrade maturity model. The last part (F) gives the target organisation an opportunity to evaluate its own ESSQ management and its different sectors using the Toddlergrade maturity model and its instructions.

All individual interview results were analysed, and when appropriate, compared to the literature. The Toddlergrade maturity model was chosen as the maturity model of the research for its four important characteristics: it is simple, transparent, it can be applied to companies of different sizes operating in different fields of industry, and it allows rapid assessment of a company. Finally, conclusions were drawn based on the analysis.

This dissertation consist of five individually journal articles and this summary, which is organised as follows: chapter 2 presents the theoretical foundation for the research; chapter 3 summarises the research contribution of the five journal articles, which are attached at full length in Appendix; overall findings of the research are summarised and analysed in chapter 4; and finally, chapter 5

summarises the research. All five of the journal articles have already been published in international professional journal publication.

2 Literature review

2.1 Theoretical frame

This chapter 2 presents the theoretical foundation for the research. This theoretical foundation of this dissertation is based on the integration of the environmental, safety and quality management, and the utilization of the EFQM model (Fig. 3). The integrated ESSQ management system acts as the framework for research. The main theoretical foundation lies on the approach, framework, benefits and challenges of the integrated ESSQ management system and the utilization of the EFQM model. The environmental, safety and quality management are first discussed separately in order to shed light on the background, logic and framework of the integrated ESSQ systems approach. The EFQM model as a business quality award model is also examined as a possible tool for the integration and development of management systems. For practical reasons, other relevant management theories and aspects critical to operational and business management have been excluded, because the scope would have extended beyond the limits of a single doctoral dissertation.

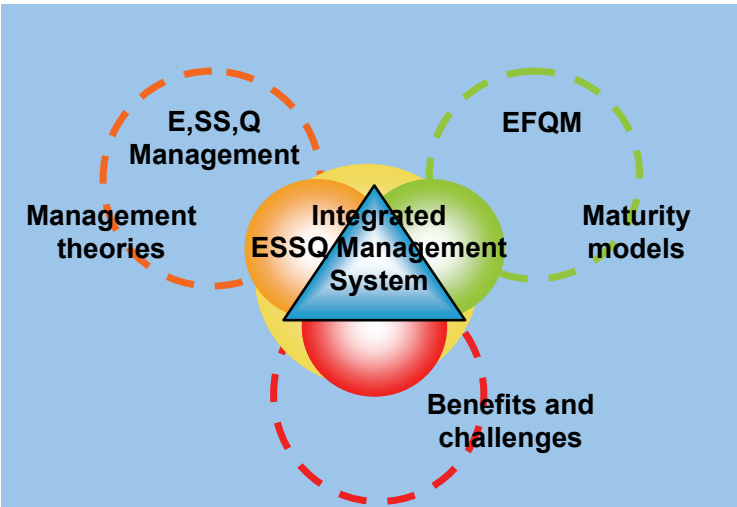


Fig. 3. Theoretical framework of the dissertation.

During the last decades, change, continuous improvement and development have become commonplace everyday activities in organisations. Competition is

becoming fiercer, the importance of meeting the customers' demands is increasing and other interest groups put more pressure in environmental and safety issues. The quality approach has also evolved to meet the requirements of modern society. According to Martín-Castilla and Rodríguez-Ruiz (2008), business excellence now incorporates a strong sense of social responsibility, in addition to the idea of customer-based operations, process approach and optimisation of resources.

The continuous need of organisations to develop their operations and to improve competitiveness and efficiency has created the need for a systems approach (see e.g. Karapetrovic & Willborn 1998, Von Ahsen & Funck 2001, Beckmerhagen *et al.* 2003). Environmental, safety, quality and other operating systems based on different standards are the building blocks of organisations. Organisations try to integrate these separate operating systems in management systems that cover the whole organisation in order to eliminate overlapping operations and structures. Integrated management systems are considered as a tool that can be used to achieve excellent business management. (see e.g. Dennis 1997, Voutilainen *et al.* 2001, Beckmerhagen *et al.* 2003, Labodová 2004, Zeng *et al.* 2005, Jørgensen *et al.* 2006, EFQM 2007)

According to Wilkinson and Dale (2002) the integration of management systems is rapidly becoming necessary to organisations regardless of their size, location or field of industry. This is also partly due the uncontrolled increase in the number of systems standards. Organisations are, in general, moving from separate independent operations towards integrated systems. Different management systems work as a framework, an operating method and support for continuous improvement. There is no universally applicable all-inclusive management system; instead, integration must be based on the organisations own goals – what the organisation wants to integrate, control and obtain. (see e.g. Wilkinson & Dale 2000, Beckmerhagen *et al.* 2003, Karapetrovic & Jonker 2003, Jørgensen *et al.* 2006)

Different kinds of maturity models have been developed for the assessment of a number of areas and viewpoints to support the pursuit of excellent business management (see e.g. ISO 14031 1999, O'Reilly *et al.* 2000, Putnam 2002, Chrissis *et al.* 2003, Nevalainen 2005, Staples *et al.* 2007, SEI 2008, Nadcap 2010) The EFQM model and other so-called quality award models, for example, the Japanese Deming Prize and the US Baldrige model assess the excellence of the entire organisation. They are not focussed on quality issues only, but they cover the entire operations of an organisation. (see e.g. Porter & Tanner 1998, Rusjan 2005, EFQM 2007) If maturity models are used, it is paramount to

incorporate them in all operations of the organisation (see e.g. Ritchie & Dale 2000, Voutilainen *et al.* 2001, Samuelsson & Nilsson 2002). Social responsibility and strong emphasis on the needs of customers and interest groups are also an important part of integrated management systems, which creates a link between quality award models and integrated management systems. (Voutilainen *et al.* 2001)

Management as a science and an area of research can be divided into a number of different research traditions. Difficulties arise in tracing the history of management. Some see it by definition as a late modern conceptualization. On those terms it cannot have a pre-modern history, only harbingers. Others, however, detect management-like-thought back to e.g. Sumerian traders and to the builders of the pyramids of ancient Egypt. Research in management and organisations is based on the Industrial Revolution in the West in the 19th century. Good leadership and management have always been considered to be of paramount importance, and there is therefore plenty of research available. However, there is no single all-inclusive and commonly accepted theory; instead, research consists of several dogmas. Management usually considers leadership and management systems separately. Leadership refers to the individual properties of a person and his behaviour. Management systems consist of management dogmas, models and tools that are jointly used by a member of the organisation. These management models include, among others, environmental management, safety and security management and quality management. Management is, if simplified, will and skill to make an organisation and its different parts to act as required. Leadership in practice means work for meeting the goals set for the organisational results and other aspects.

Research and development in the organisation of work were founded on increasingly fierce competition, automated large-scale industries and hired corporate management. Current management dogmas have often been created in companies from where they have spread to other areas. The distribution of work is an ancient invention of human beings, which leads to the benefits of specialisation. Charles Babbage's (1792–1871) *On the Economy of Machinery and Manufactures* (1832) is among the first renowned studies in the field. Babbage emphasises, among others, the distribution of work and specialisation. The best-known classic author in organisation research is Frederic Winslow Taylor (1856–1915), in particular with his main work *The Principles of Scientific Management* (1911). In his theory of scientific business management, Taylor points out that clearly defined distribution of work, specialised personnel and

clear supervisory relations are characteristics of a well-functioning organisation. Taylor's principles include a view on efficient organisation and motivating personnel. Criticism towards his work created in the new principle of 'management by objectives' based on decentralised responsibilities, which is often considered to have been founded by Peter Drucker (1954). The main concept behind 'management by objectives' is to manage by setting goals and utilising personal observation. (see e.g. Drucker 1959, Humble 1979) Different areas and categories and implementations of management can be found more than enough.

In the 1920's statistical theory began to be applied effectively to quality control, and in 1924 Shewhart made the first sketch of a modern control chart. His work was later developed by Deming and the early work of Shewhart, Deming, Dodge and Romig constitutes much of what today comprises the theory of statistical process control (SPC). However, there was little use of these techniques in manufacturing companies until the late 1940's. At that time, Japan's industrial system was virtually destroyed, and it had a reputation for cheap imitation products and an illiterate workforce. The Japanese recognised these problems and set about solving them with the help of some notable quality gurus – Juran, Deming and Feigenbaum. (see e.g. Deming 1986)

In Japan during that time was observed that improvement of quality beget naturally and inevitably improvement of productivity. Improvement of quality transfers a chain reaction: cost decrease because of less rework, fewer mistakes, fewer delays, snags, better use of machine-time and materials; productivity improves; capture the market with better quality and lower price; stay in business; provide jobs and more jobs. In the early 1950's, quality management practices developed rapidly in Japanese plants, and become a major theme in Japanese management philosophy, such that, by 1960, quality control and management. Also system engineering has already been a subject of interest since the late 1950's and early 1960's (Blanchard 2004). The successful implementation of system engineering requires not only a technical thrust, but a management thrust as well. Feigenbaum (1969) used the first time term "total quality" referred to wider issues such as planning, organisation and management responsibility. Later Ishikawa specify it's meaning "company wide quality control", and describing how all employees, from top management to the workers, must study and participate in quality control. (see e.g. Deming 1986) As we moved into the 21st century, total quality management TQM has developed in many countries into

holistic frameworks, aimed at helping organisations achieve excellent performance, particularly in customer and business results.

Management operates through various functions, often classified as planning, organizing, leading/directing, and controlling/monitoring. Already Fayol (1841–1925) specified that the key common components in a general management system are: planning, organisation, giving orders, coordination and monitoring. Planning means that an organisation must look forward and secure its future. Lack of planning means lack of business competence. Planning can be continuous, flexible, targeted and long-term. Organisation provides an entity with the prerequisites for operations. Giving orders refers to leading and managing people operating in an organisation. Coordination means the harmonisation and matching of operations on the way to success. Monitoring refers to controlling that operations are carried out as planned. If required, remedial measures are taken. (Oldcorn 1989)

Kotter (1990) observes that a general management system consists of the following sub-categories: planning and budgeting; organisation and manning; control and problem solving. The objective of planning and budgeting is to set goals and objectives, define intermediate goals and allocate resources needed to meet the goals. Organisation and manning aim at defining the organisational structure, jobs and responsibilities, as well as the implementation of monitoring systems. Controlling and problem solving illustrate the necessity to monitor progress with respect to the plans made, recognise deviations from the plan, and planning and organisation related to problem solving.

According to Vanhala *et al.* (2006), companies are organisations that require management input in order to function. Management refers to conscious and goal-oriented actions that are aimed at influencing things. For this, the company needs three basic elements: 1) defining the company's business, goals and operating guidelines, 2) building a well-functioning organisation that consists, first and foremost, of human resources and 3) human resources management. Business management must cover all these areas, each of which contains many sub-tasks and details. In addition, these vary depending from the field of business, size of the company, its development stage, and its social and financial status.

Management system can refer to, on a general level, the definition of organisational policy and goals and the system that is used to achieve the goals set. A management system can be seen as an organised group consisting of various components that the organisation can use to achieve one or more of its goals. The goals set by an organisation can be, for example, facilitating the communication

of information, decreasing environmental impacts, minimising the number of accidents and near-miss situations or improving overall quality level. A good management system helps the organisation to develop the right issues, that is, issues that should be developed in any case and it optimises the operations of an organisation by clarifying the relationships between different operations, helping to manage these relationships and thus directs the organisation towards becoming a learning organisation. (Dennis 1997)

Different views and approaches to efficiency play a central role in organisational theories. Organisational theories aim to create operating principles that make the operations of organisations more efficient. The objective is to find principles that prevent various sub-systems becoming isolated from the other operations of an organisation and that link sub-systems together in such a way that their operations support other functions of the organisation. Efficiency is thus often considered to be the goal of the existence of organisations. Efficiency is usually defined through its components. These components of the operations of an organisation are inputs, operating or production process, output and outcome. Inputs are often measured by means of costs. Knowledge and technology, however, create new inputs, in which case intellectual and volume resources can be included in them. Resources are turned into output in the operating and production processes. Outcome means the change caused by operations. In administration theory, efficiency usually refers to comparing outputs with the inputs and resources needed to produce them. This is commonly known as productivity-oriented definition of efficiency. (Tikka 1985)

Constant changes create various disturbances and require the organisation to learn. Change is not always necessary but it is often needed to develop things in a positive way. A learning organisation is an ideal organisation that learns through the individuals in it. It is, however, more than the sum of the things learned by individuals, which means that learning must be understood both from the viewpoint of the individual and the entire group. According to Gunn (1992) ultimately people are the answer – the key to gaining and sustaining the winning edge. A learning organisation is flexible, because it has a common vision and committed, inspiring leader. According to Bradford & Cohen (1984) leadership is the key to raising mere adequacy to excellence. The employees' professional skills are developed and participation is diverse. The organisation applies a systematic approach, which means that it understands the relationships between sub-systems and separate components of an entity. Learning and communication of information is open and efficient, the organisation utilises metrics and reward

systems that support development. The learning of an organisation means approaching an organisation from the level of an individual, team and the entire organisation by simultaneously considering people, structures, systems and management. (Strömmer 1999) According to Hamel (2000) radical innovation is the competitive advantage for the new millennium – it is possible to design a processes that will meet that goal without killing innovation.

According Deming (1986) a company must make use of the store of knowledge that exist within the company, for its very existence, and learn how to make use of help from the outside when it can be effective. The central problem in management, leadership and production is failure to understand the nature and interpretation of variation. Effort and methods for improvement of quality and productivity are in most companies fragmented with no overall competent guidance and no integrated system for continual improvement. It is important to make optimum use of knowledge and for continual development of people and processes. Failure of management to foresee problems has brought about waste of manpower, material and machine-time, all of which raise the company's cost and price that the purchaser pay. Performance of management should be measured by potential to stay in business, to protect investment, to ensure future dividends and jobs through improvement of product and service for the future, not by the quarterly dividend. The first step in the management transformation is to learn how to change: that is to understand and use the management for transformation of company and to cure themselves of the diseases. Adoption and action such a system are a signal that the management intend to stay in business and aim to protect investors and jobs. (Deming 1986)

There is an ever-increasing need to develop and produce systems that are robust, reliable and of high quality, supportable, cost-effective, and that will respond to the needs of the customer in a satisfactory manner. According to Berchard (2004) it is now more important than ever to ensure that the principles of system engineering are properly implemented in both the design and the development of new system and/or reengineering of existing systems. The system must be viewed in terms of all of its components on a totally integrated basis: prime equipment; software; operating personnel; facilities; data and information; the production and distribution process; and the elements maintenance and support. Integrated approach must be assumed from top-down with appropriate allocation of requirements from system level and down to its various elements. It is necessary that one select the appropriate technologies, utilize the proper analytical tools, and apply the necessary resources to enhance the system

engineering process. It is necessary to understand and believe in the process and to establish the proper management and organizational structure that will allow it to happen. This approach provides a cultural challenge. According to Drucker (1999) the center of a modern society, economy and community is the managed institution as the organ of society to produce results. Management is the specific tool, the specific function, the specific instrument to make institutions capable of producing results.

Management system may refer to the entity that consists of goal setting and monitoring, management of material and intellectual resources, and instructions and practices. The entity is used to manage, analyse and develop business. The management system may meet the requirements set for environmental, safety and security and quality management in standards and specifications in the scope that is appropriate for the business in question. The entity is managed through expertise and understanding, and the knowledge of the management system for one's own operations forms an integral part of the professional skills of the person in charge.

Management systems are created of several administrative and operational systems and the related documentation. The management systems can meet the requirements of, among others, the ISO 14001 and 9001 standards and OHSAS 18001. In that case the part of the management system that meets the requirements of quality management standards is aimed at ensuring the application of quality management principles in operations, development and compliance of products. Meeting the environmental criteria supports environmental protection, prevention of contamination and continuous improvement taking the social and financial needs into account. Safety management refers to the protection of people, environment and property, and goal-oriented development of safety.

The exploitation of maturity models e.g. the EFQM model, and integrating them in the company's management system is a result of development in management systems. Maturity models create a good basis for the development of competitiveness and excellence. The models are based on the characteristics of excellence, but they do not dictate in great detail what kind of measures should be taken. Models can also be used for a variety of purposes, such as self-assessments and making comparisons to best practices. In practice, maturity models are being integrated as an integral part in the strategic planning process, process-oriented practical operations and monitoring systems e.g. by carrying out audits that utilise the existing operating models of the corporate management system used in the

said organisation. The models make corporate strategy planning, continuous improvement, monitoring and learning increasingly efficient and systematic.

The essential factor in using maturity models that are integrated in management systems is not the use of the tool as such; instead, the essential thing is to incorporate the characteristics of excellence as central parts of corporate strategy and business. The correct content and direction of business are of paramount importance, and corporate strategy and goals must reflect them. Business result is today increasingly made by exploiting know-how. The management of intellectual capital and know-how has become an increasingly important competitive factor in recent years. Innovation and learning play a key role in maturity models. The efficient modernisation of operations is often carried out by means of small, yet determined and continuous improvements. Maturity models are most efficient when considered as an integral part of overall business development of a company, not as a separate partial solution. There is always room for improvement, though, and therefore tools and resources must be reserved for further development.

2.2 Environmental management and contribution to operational and business excellence

Environmental management is the management sector focussing on the overlapping areas of environmental protection and business. Sustainable development means that the environment, people and financial aspects are equally considered in decision making and business operations. Environmental management means responsible business practices that comply with the principles of sustainable development and management, especially from an environmental point of view. Environmental management allows the integration of operational decisions concerning environmental issues into the company's management and decision-making system. The concept of environmental management can accommodate a number of different matters. Environmental management is usually used within the framework of strategic decision-making and corporate management. It is recognised that companies can gain competitive advantage by utilising environmental management, when they use innovative actions that surpass the demands of environmental legislation (Johnson & Walck 2004, see also Halkos & Evangelinos 2002, Stratchan & Lal 2003, Wee & Quazi 2005)

Environmental management is often considered to be directly connected with environmental management systems, for example, the standards of the ISO 14000

series. Obtaining an environmental certification is expensive if it is merely added to the existing practices of a company's existing in order to gain more favourable reception from consumers. However, if sustainability goals are integrated into the core business values, they can save enough costs to balance the high costs of compliance to standards. (Johnson & Walck 2004)

Environmental management standards are, in part, based on the ISO 9000 quality management system standard. After its publication, the environmental management standard has been nationally developed in a number of different countries: one of the first national standards completed was the British BS 7750 standard, which has also been used for certification outside Britain. The international ISO 14000 environmental standard series was published in 1996, and it has since become the most popular environmental management standard. The most important aspect of the ISO 14001 standard, similar to other environmental standards, is the commitment to continuous improvement, which may include, among others, energy efficiency, decrease in emissions or better use of raw materials. (Rohweder 2004) An updated version of the standard was published in 2004; the changes compared to the previous version published in 1996 were small. The updated version has been better harmonised with the ISO 9000:2000 standard and it emphasises the compliance with environmental legislation and regulations, in addition to which the management review process has been described in more detail. (Jørgensen *et al.* 2006)

The environmental management system is the part of the general management system of an organisation that contains organisational structures, planning operations, responsibilities, practices, procedures, processes and resources for the development, implementation, achievement, auditing and maintaining of environmental policy. (Moisio & Tuominen 2003) The environmental system creates a model for the company on how to operate in order to meet the goals set for environmental issues in corporate strategy. The creation of a corporate environmental management system is commenced from the environmental vision of the company. The vision defines long-term goals and actions for the development of environmental aspects of its operations. In some fields of industry, companies may prepare a separate environmental strategy. This is justified when the level of the company's environmental management is continuously monitored and it significantly affects business decisions. Environmental policy includes the company's environmental goals and objectives that adhere to the principles of sustainable development and continuous improvement. The environmental action plan contains plans and instructions on

how to achieve those goals. The environmental system defines the measurement points and measurements for the assessment of environmental issues related to the company's operations and environmental reporting. (Pohjola 2003)

According to the ISO 14001 environmental management system the organisation: creates an appropriate environmental policy and recognises environmental issues related to its previous, current and future operations, products and services in order to define significant environmental impacts; recognises statutory and other requirements that the organisation has committed itself to; recognises the priority of issues and sets appropriate environmental goals and objectives; creates an organisation and programmes to execute its environmental policy and ensure that goals are met; ensures that there are prerequisites for planning and control, preventive and remedial measures, audits and review that help to ensure that the policy is executed and the environmental management system is suitable for its purpose; and remains flexible in changing conditions. (SFS EN ISO 2008)

The benefits of environmental management systems and their importance to both organisations and the environment have been assessed, but the results are partly contradictory. On one hand, costs are saved as material and energy flows become more efficient but, on the other hand, the added value gained – in particular in small production centres – is not significant. The image of the company has been assessed to improve but, again, not significantly. The new systems and development of environmental issues thus create the greatest benefits to those organisations that are among the first to implement the improvements. (Rohweder 2004)

A study carried out in the United States asked industrial companies of different sizes and types about the impacts of the certification of the ISO 14001 standard. A total of 177 companies replied. The companies were asked to reply to three important questions: how long did it take them to obtain ISO 14001 certification (in months)? What components of the ISO 14001 standard required significant investment? What were the major problems encountered by the companies when implementing the ISO 14001 standard? Most companies (75.6%) needed from 8 to 19 months to obtain certification. Only three companies managed to obtain certification in 3 months or less. Ten companies needed 20 months or longer to obtain certification. The aspects requiring most work and investment were the recognition of environmental issues and documentation related to the environmental management system. The biggest problem encountered in the implementation process was high costs. Costs were created by

extensive documentation, training of employees and costs related to the third-party audits. Another major problem in implementation was lack of resources. (Babakri *et al.* 2003)

According to a global research study by Raines (2002), most companies are satisfied with the impacts of the ISO 14001 standard on their business revenue, possibility for international trading and possibility to improve their environmental performance. In addition, the study showed that 97% of the companies expected the standard to create both short- and long-term improvements in their environmental performance. The standard also improved relations with regulatory authorities. The main motives for the implementation of the ISO 14001 standard were to demonstrate their leading position in environmental issues, create cost-savings, advantages offered by the “green” market and requirements set by interest groups.

Environmental management is also associated with different environmental management tools, in which case it is seen as a rather technical solution. Companies can improve the efficiency of their operations and report the enhanced results to their interest groups using environmental management tools such as life cycle assessments and environmental reports (Kallio 2001). Environmental management is sometimes considered from the perspectives of business ethics and the social responsibility of companies. Companies are expected to assume an increasing amount of social responsibility, and the natural environment is often considered a new business stakeholder. Without the trust of the public, all efforts, promotion or achievements will fail to create a perception of environmental excellence (Kallio 2001, Rice 2003).

According to Pohjola (2003), the three requirements set for an environmental management system are: 1) The environmental management system must be extensive and cover all operations of the organisation, 2) The system must be understandable to all employees of the company and 3) The system must be assessable and the company’s personnel must be committed to the continuous improvement of environmental issues. The company’s values, business vision and business strategy (possibly including a separate environmental strategy) create the guidelines for the company’s business that is in compliance with the principles of sustainable development (see Fig. 4). The environmental policy, goals and their management are formulated in accordance with the company’s definition of its environmental responsibility.

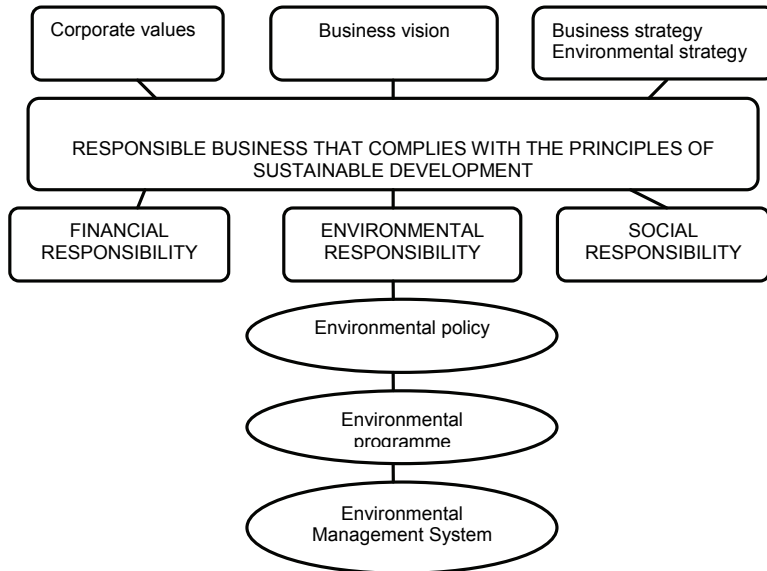


Fig. 4. Responsible business operations that comply with the principles of sustainable development (Pohjola 2003, published by permission of Talentum Media Plc).

One of the main objectives of modern environmental management is to gain financial profit in such a way that the environmental impacts of business operations are minimised, taking the financial and profitability aspects into consideration. In this case, environmental aspects are taken into consideration and environmental impacts are minimised; however, not in a proactive or an altruistic way that would surpass financial profitability. Even the most innovative forms of environmental management may become a burden to a company if environmental management tools compromise the objective of gaining sufficient financial, competitive, or other business advantages such as social legitimacy (Kallio 2001).

As far as the profitability of a company is concerned, it is of paramount importance to seek a balance between environmental measures and market expectations. Even though a company is superior to all of its competitors in terms of environmental performance, it may not necessarily provide it with an environmental competitive advantage (Karagozoglu & Lindell 2000). According to Moneva and Ortas (2008), there is a limited correlation between sustainability performance and financial performance. Evidently, European companies do not seem to be encouraged by the stock markets to adopt more sustainable forms of activity and a more proactive stakeholder action is required to promote better

business practices. Further research is needed on this subject; comparison with other relevant markets and new methodologies would be an academically and financially interesting field of study.

The competitiveness of a company consists of many different components, for example, material efficiency, quality of products, interest group relations and risks. Competitive advantage is created when the existing business processes are enhanced by introducing environmental management aspects. In addition, a positive environmental image based on facts and good management of environmental issues is a valuable asset in the markets. The concrete advantages of a well-functioning environmental management system include cost-savings due to the decreased energy consumption and waste production, and the reduction of environmental load through the selection of raw materials. In addition, reusing waste may provide new opportunities for making profit (Kallio 2001). Sustainable technology and its applications do not require technological development that promotes a cleaner environment only. In addition, they will need a stable and healthy economy (see e.g. DeLong *et al.* 2007).

Companies can create new demand, seize new market opportunities and meet the expectations of their interest groups through open interest group communication and environmental expertise. In order to support the ecological competitiveness of a company, environmental management should be all-inclusive. The ecological competitiveness of a company is a sum of a number of different factors presented in Fig. 5. A corporate environmental management model should cover all the operations of an organisation, relationships between them, and communication and reporting channels. This way, the different parts of an organisation can be linked together and the division of responsibility for the completion of the most important tasks can be ensured (Niskala 1997). An environmental management system that is compatible with shareholder values can significantly reduce the number of potential conflicts between the company's environmental and financial goals (Schaltegger & Figge 2000).

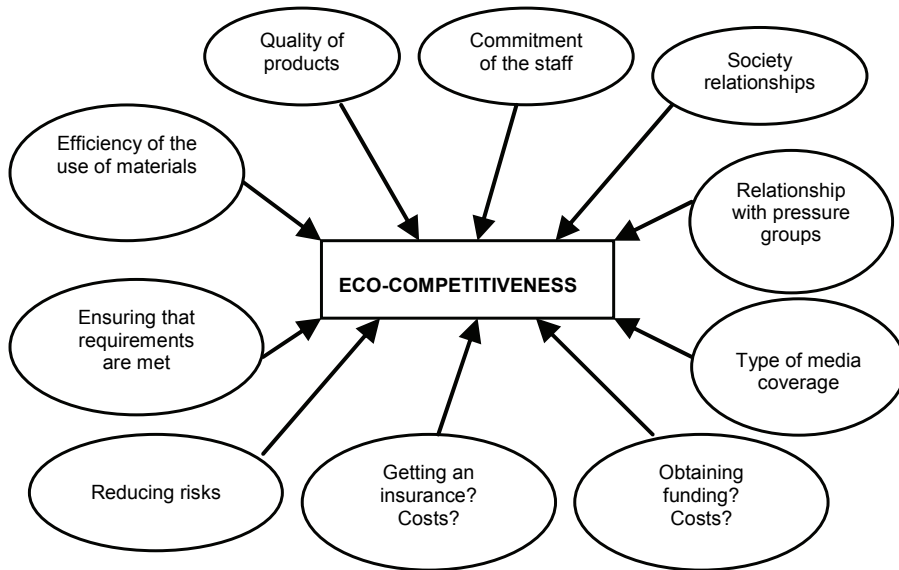


Fig. 5. Components of eco-competitiveness (Niskala 1997, published by permission of Tilisanomat).

2.3 Safety management and contribution to operational and business excellence

Safety and security concept can be defined as a state or status of a system in which all business-related risks are at an acceptable level (Simola 2005). *Safety* is mainly related to unintentional accidents, incidents and losses, whereas *security* contains the aspect of intentional damage, crime and terrorism. *Safety management* combines the different fields of safety into one entity and thus functions as the coordinator of different sectors of safety.

Corporate safety means the holistic management of all safety issues of a company (Kerko 2001). The objective of corporate safety is to protect against accidents, harm, misuse and crime and ensure the legitimate operational prerequisites of a company, as well as undisturbed production and operations (Laatunen 2005). Corporate safety is managed by means of safety and risk management (Lanne 2007). *Risk management* refers to systematic operations that include risk assessment, and the planning, implementation and monitoring of the required measures, as well as remedying measures possibly needed. The sectors of corporate safety are personnel safety, rescue operations, safety against crime,

data security, safety of buildings and premises, safety of production and operations, occupational safety, safety of non-domestic operations, readiness planning and environmental safety. (YTNK 2005)

Measures used for ensuring corporate safety can be divided into different sectors that have common goals and procedures but that are kept separate by their different development histories. There is no actual management model for corporate safety; instead, many companies have developed all sectors as separate entities. In large companies, operations and responsibilities for different safety sectors are decentralised in different parts of the organisation. (Kerko 2001, Lanne 2007) The objective of a safety management system is to control safety policy and planning. Other important sectors are organisation and communication that focus on the definition of responsibilities and creation of communication channels. Safety systems are also used to pursue the management of audit and assessment. (Oedewald & Reiman 2006)

Kerko (2001) defines corporate safety and security as all-inclusive management of all safety and security issues of a company. Leppänen (2006) complements the concept of corporate safety and security with the notion of organisational safety and security. The achievement and management of corporate safety require efficient risk management and safety management from the organisation. Corporate risk management policy directs the planning of corporate safety management, and successful safety management directs the development of risk management. Safety and security management and risk management together create a mutually supporting cycle. (Lanne 2006) In addition to safety management, and risk management, the organisational culture, learning and interaction have an impact on the level of corporate safety and security (Fig. 6). (Lanne 2007)

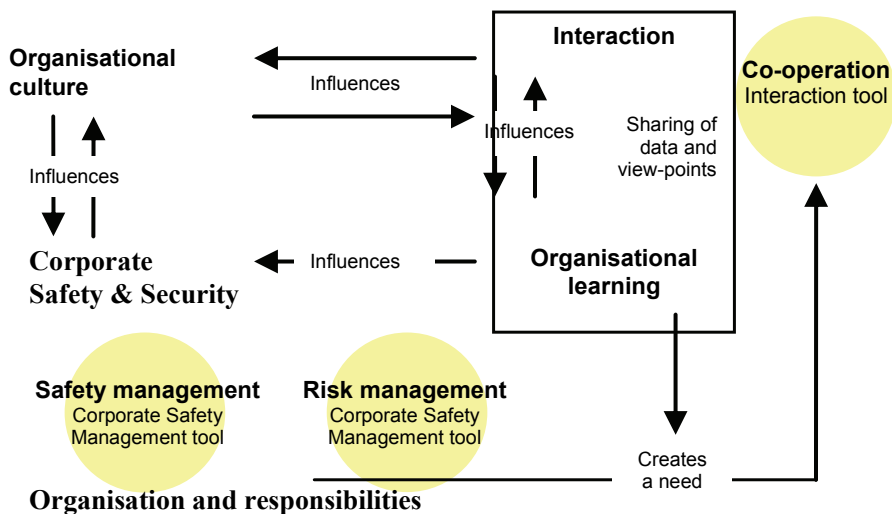


Fig. 6. Factors affecting corporate Safety and Security (Lanne 2007, published by permission of VTT Publications).

If there is a positive corporate safety culture, the organisation's formal management systems and leader's informal management practices facilitate caring amongst employees by encouraging, recognizing and promoting safe behaviour (Afrazeh & Bartsch 2007, Choudhry 2007). According to Hale *et al.* (1997), safety management focuses on regulations, responsibilities, hierarchy of an organisation, plans and policies. In addition to these structural components, internal factors of an organisation, such as social factors, must be taken into account. Social factors are composed of human resources, the method of handling problems and conflicts of interest, as well as the reconciliation of different goals, values and views. The reconciliations dependence and interaction between technical and social systems should be taken into consideration when modelling the operations of an organisation. (Gheorghe 1996, Levä 2003)

Safety management links different safety sectors into one whole and therefore works as a coordinator between the sectors. Safety management combines the management of methods, practices and human resources; it consists of continuous planning, action and follow-up. It also includes both anticipatory and remedial actions, which continuously improve the working environment. Safety work should be a natural part of everyday operations and it should be integrated in all work carried out. (Oedewald & Reiman 2006)

Reason (1997) divides safety management into three different categories: the safety management of people, machines or equipment, and organisation. The third category indicates that human error is more a result and it reveals the weak points in the system. There are certain characteristics that are common to organisational model and total quality management model (TQM). The organisational model also underlines the importance of anticipation and continuous improvement of the system. The improvement of quality and safety will result in a higher level of risk prevention, which forms the basis for an integrated management model. A number of authors e.g. Herrero *et al.* (2002) speak for the idea that the concepts of TQM can be applied also to safety practices.

Many organisations have started to use an occupational health and safety system in compliance with OHSAS 18001 specification. The systems combine the management of methods, procedures and human resources management. The occupational health and safety system covers both preventive and remedial actions that continuously improve the working environment. The said safety system is a part of the general management system of an organisation and it includes organisational structures, planning operations, responsibilities, practices, procedures, processes and resources for the development, implementation, achievement, audit and maintenance of safety policy. (OHSAS 18001) The same system can be applied, in a generic manner, to the entire safety management of a company.

The first safety management system applications were based on the British Standard occupational health and safety management system (BS 8800) and the Dutch Safety Checklist for Contractors (SCC) standard. BS 8800 was later replaced with the international Occupational Health and Safety Assessment Series specifications (OHSAS 18001) in 1999. OHSAS 18001 contributes to the assessment and certification of the management systems of different kinds of organisations. OHSAS 18001, published in 1999, was designed to be compatible with the ISO 9001:1994 quality management system and the ISO14001:1996 environmental management system in order to allow the integration of the said systems should the organisations so wish. (Jørgensen *et al.* 2006)

In addition, the International Labour Organisation (ILO) has published instructions on Occupational Health System (ILO-OHS 2001). The International Safety Rating System (ISRS 1996) is a method that can be used for auditing safety management procedures and the functionality of systems. The method can also be applied to environmental and quality issues. The self-assessment model for evaluating the safety practices of an organisation complements the EFQM

Excellence Model (European Federation for Quality Management) by including occupational health and safety issues in a more comprehensive manner. (Levä 2003) The integration of, for example, occupational health and safety issues into environmental management systems may bring many benefits to industrial companies. The companies can eliminate overlapping operations and find optimal solutions, because the prevention principles used in environmental protection and safety management are similar (Honkasalo 2000).

A safety management system consists of risk assessment and management, safety management models, corporate safety culture, controlling of safety costs, standards, safety policies and instructions, insurances, co-operation with the authorities and interest groups, measurement and development of safety operations, integration of safety operations in the daily business of the company and communication of information on safety issues. (Oedewald & Reiman 2006) Safety management includes all sectors and operations that are needed to ensure that the company meets its goals and that protected sites remain undamaged. (Leppänen 2006) Safety management is a continuous process and it creates a circle entailing policy and goals, planning, implementation, monitoring, assessment, development and remedial measures and continuous improvement. (Lanne 2007)

A company's safety management is based on safety policy that should be integrated into all operations of the company in order to harmonize it with all the company's goals. (Hämäläinen & Lanne 2001) According to Reason's (1997) model, profitability and the protection of people, environment and property are mutually dependent (Fig. 7). According to Reason's model, the more a company faces high hazard ventures the more it needs to invest in protection. Protection, however, consumes the resources of production, such as money and labour. Therefore, extremes should be avoided so that the profitability and production goals set could be met. However, merely improving production at the expense of safety may result into a serious incident or catastrophe.

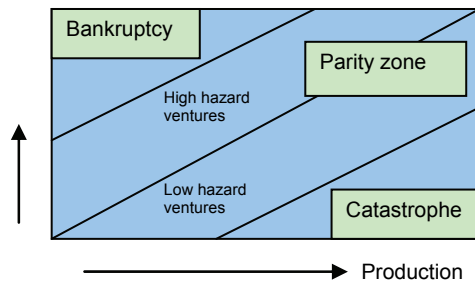


Fig. 7. Correlation between profitability and protection (Reason 1997, published by permission of Ashgate Publishing Limited).

Several different operators participate in the safety operations of large-scale companies, and the different sectors of safety and risk management are often covered in various parts of the organisation. In addition, risk assessment may only examine risks from the viewpoint of one safety sector, and the results of a separate risk assessment do not reach the different representatives of safety organisation. Assessing different safety sectors separately may lead to the situation where improvements are only made to the narrow sector in question. Then, the impacts of the measure for the overall safety of the organisation are not considered. The best solutions, from the viewpoint of overall safety, can be found by assessing the impacts of the improvement measure with respect to all safety sectors. The objective is to avoid overlapping risk assessments of different sectors and wasting of resources. Increasingly holistic safety management can be reached by increasing co-operation between people in charge of different safety sectors. (Lanne & Tytykoski 2004)

Miettinen (2002) presents an entity of corporate safety that includes, in addition to the aforementioned sectors, corporate safety management, corporate safety risks and threats, protective measures, objects to be protected and core business. According to Miettinen, the entity must include other aspects than the mere sectors of safety. A company develops and maintains its corporate safety in order to protect its core business. Practical measures are often targeted at protecting data, core expertise, processes and resources. The company decides what it wishes to protect against risks and threats, which means that corporate safety is a part of the risk management of a company. Corporate safety risk refers to unwanted events possibly affecting the operations of a company, and corporate safety threat is a possible dangerous event created by a realised risk. Protection

against risks can be done by means of technical or non-technical solutions. Corporate safety management entails all sectors of corporate safety.

Overall corporate safety is a concept that has not established its position with regard to any specific content. It is usually used when one wishes to take separate viewpoints into account when examining safety issues. (Lanne *et al.* 2004). The management's role in safety management is to be responsible for, and direct, safety. It helps to ensure the statutory operating prerequisites of a company, undisturbed production and services, continuity and a safe operating environment. Corporate management is also ultimately responsible for corporate safety, and it is the managing director's responsibility to organise all resources required. The management is also responsible for defining responsibilities and the organisation of safety management. The management's task is to define the organisation and planning of strategic safety work, practical implementation of safety measures, the organisation of self-assessment in workplaces and general risk assessment of the company. (Kerko 2001, Laatuinen 2005, Oedewald & Reiman 2006)

Lanne (2006) emphasises that, although safety operations are in the responsibility of the senior management, companies also need safety experts to coordinate and analyse safety measures and draw up safety plans. In practice, operative safety is created when line management and employees comply with common rules of corporate safety. Superiors who are responsible for financial results are also responsible for the corporate safety of their business unit. Safety experts may support the work of line organisations but responsibility cannot be allocated to them if it is not allowed by the organisation's rules. Corporate management has the legal responsibility for safety whereas corporate safety experts are responsible for the professional aspects of corporate safety. (Laatuinen 2005, Oedewald & Reiman 2006)

Commitment of the management and true actions are the cornerstones of successful safety management. If the corporate management lacks commitment to improve the level of safety, it will not be done. The development of safety culture is one of the most important factors in the way towards successful safety management (Choudhry *et al.* 2007). Commitment to goals should be sincere because if the management does not genuinely believe that improving safety can be profitable they will not allocate all the resources needed. The principles of safety approach must be incorporated in the everyday work of every member of the organisation from the top management to workers. Safety should not be a separate system but a natural part of everyone's daily work. (Hill & Smith 1995, Mottel *et al.* 1995, Hansen 2006) Flin and Mearns' (1994) study in offshore

environments showed that the management's commitment to safety and job satisfaction, their attitudes towards safety versus production and job situation had the greatest effect on the workers' perception of risks and their satisfaction with safety measures.

DuPont is one of the largest chemical companies in the world and it is often considered a forerunner in safety issues. Creating a safety culture usually takes a long time, but DuPont succeeded in creating one in only two years. This was done by replacing the key people in managerial and supervisory tasks with people who had well endorsed DuPont's safety culture. (Simola 2005) The previous example shows that the development of safety culture is one of the most important factors in the pursuit of successful safety management.

Successful safety operations significantly improve work satisfaction. The satisfaction and wellbeing of employees should be taken seriously, because it directly correlates with productivity. In addition, wellbeing at work reduces the number of accidents and mistakes: unhappy employees are more prone to error. (Hansen 2006) The areas of responsibility in safety issues must be clearly stated and the responsibility of the line organisation must be underlined. The supervisors are responsible for monitoring the situation and they must intervene with risk taking of all kinds. Employees should have access to instructions for the planning and use of the factory, processes, equipment and storage areas. (Levä 2003)

Successful companies focus on surpassing themselves, not their competitors. It is more important to carry out an in-depth examination of operations than to examine visionary statements. Everyone has to fully comprehend the expectations, and the company's goals must be set formulated in a clear, understandable way. The goals must also be updated when necessary, in order to create a positive cycle towards the improvement of the safety level. The achievement of the goals is checked by means of regular measurements. If safety level is implemented as an important metric, safety management also becomes increasingly important. The emphasis should on the building and enhancing the process, not on the results. For corporate safety, this means that one should not only focus on incident statistics but it is more advantageous to analyse the anticipatory metrics of the process. Then, it is possible to gain information on the accuracy and correctness of the measures taken. (Hurst *et al.* 1996, Simola 2005, Hansen 2006)

Other essential requirements for successful safety operations are the motivation, empowerment and participation of employees in safety work. Personnel can be motivated for safety work, for example, by giving positive feedback and emphasising the positive financial aspects. A number of studies e.g.

Flin *et al.* (1996) and Gill and Shergill (2004) indicate that in addition to key organisational factors also individual factors, such as personal appreciation of risks and involvement in safety-related decisions, must be taken into account.

In order to succeed, a company must understand that if one wants to develop something, it must be made meaningful for the employees; otherwise it will be an uphill battle. Employees can be made aware of their importance and that the corporate management trusts them by making their work important, giving them responsibilities and authorisations. Before responsibilities or authorisations are granted, however, the personnel must be sufficiently trained and instructed in safety issues. To ensure the appropriate content of training, training needs must be carefully examined in advance. (Levä 2003, Hansen 2006) Successful safety operations significantly enhance job satisfaction and wellbeing at work. Job satisfaction and happiness of employees should be considered important, because they greatly affect the profitability of work and the financial result of the company. Job satisfaction correlates with the number of accidents and failures, which more often occur to dissatisfied employees.

According to Lanne *et al.* (2004), the assessment of the company's overall safety mainly lies in occupational safety and healthcare. Only a few sectors of corporate safety have existing implemented, systematic monitoring methods. Therefore, the perception of safety issues is, at its best, vague and the benefits gained by investing resources in safety operations cannot be clearly demonstrated. Different safety operators need to exchange a great deal of information smoothly, which sets high standards for the data management system. The amount of communication and co-operation correlate with the amount of information exchange needed. Employees must be informed of all ongoing projects and their questions must be answered in a satisfactory manner.

According to Kerko (2001), a safety management system created on the foundation of corporate safety establishes grounds for a harmonised management system and ensures consistency in terminology that is used when referring to different safety sectors. The objectives of corporate safety are to ensure undisturbed business, support the company's financial goals and ensure the high quality level of products and services. Well-managed corporate safety is also an important goodwill factor, because it contributes to the good public image of the company. Corporate safety also protects the company against accidents, harm, misuse and crime, and ensures legitimate operational prerequisites as well as undisturbed production. Depending on the company's needs, protective measures

can be targeted at a person, property, information, environment or the company's reputation. (Kerko 2001, Lanne *et al.* 2004)

Corporate safety is an integral part of the company's management and competitiveness. Corporate safety is based on a corporate safety policy, corporate safety action plan, unit and section specific operating instructions, reporting system and metrics, which describe the company's operations and results. In practice, safety work is an integral part of everyday work, and it aims at preventing accidents, near-miss events, damages and enhancing the company's readiness to act in case of such an event. (Miettinen 2002, Laatumen 2005) Different corporate safety sectors have been developed separately and at different speeds, for example, environmental safety and information security issues have been developed as separate management systems (Kerko 2001, Lanne 2004).

2.4 Quality management and contribution to operational and business excellence

There are nearly as many definitions for quality as there are authors writing about it. The leading researchers in the field of quality management define quality in a number of ways. Deming, for example, did not define the concept of 'quality' in great detail. According to Deming, variation is the most important reason for poor quality products and variation can be prevented by systematically applying statistical quality control. In addition to this general definition, Deming later summarises his statements for quality work in 14 detailed operating instructions. (Deming 1986, 1993) Juran and Gryna (1951) define quality as 'fitness for use' and 'faultless', in addition, for them quality is equal to the failure frequency (Schulzt 1994). According to Crosby (1979), quality must be defined as meeting the requirements, not as being good. For him, the metrics of quality are the costs generated due to faulty products and failures (Schulzt 1994). Shewart (1931) constructed a significant definition of quality, which was different from the common quality concept in the 1930s, when he defined quality as meeting the requirements, and not as luxury, expensive or splendid as is often emphasised in common language (Lillrank 1998).

Quality management refers to a management model which aims at the strategic control and management of quality. Quality management and its approach in an organisation must begin from the very top and it must incorporate all operations of the organisation. Traditionally, quality management has been first applied in production, after which it has been expanded to cover other

operations of an organisation. The objective of quality management is to seek financial benefits by lowering costs and increasing profit, which means better profitability of operations. Total quality management (TQM) is a philosophical entity of management and a collection of methods and techniques of quality management. Some literary sources divide TQM into hard and soft management. This refers to the organisation's approach to management in which quality plays a central role and which is based on the participation of all members of the organisation. The objective is to pursue long-term success that is achieved through customer satisfaction and that benefits both the members of the organisation and the surrounding society. (Dale 1999, Silen 1998)

Figure 8 shows the division of TQM into hard and soft management. People, processes and performance represent the hard values of TQM whereas culture, communication and commitment represent soft values. According to Oakland, the creation of strategies, co-operation partnerships and resources and quality planning are all included in planning. Oakland classifies the understanding, management and planning of processes, quality management system and continuous improvement under processes. According to Oakland, people consist of human resources management, change in the corporate culture, team work, communication, innovation and learning. Performance covers the creation of a performance assessment framework in an organisation, for example by means of a balanced scorecard, self-assessment, audits, reviews and benchmarking. These hard factors of TQM are based on the soft TQM factors such as the right kind of quality culture, communication of quality issues and commitment to produce quality and meet the customers' requirements. (Oakland 2005)

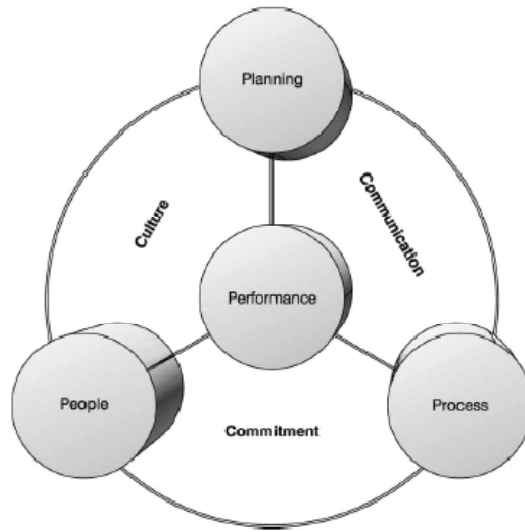


Fig. 8. TQM framework (Oakland 2005, published by permission of Taylor & Francis Informa UK Ltd).

The model presented above illustrates the common elements of TQM. The elements can, however, be classified in a different way. For example, Dale (1999) includes quality tools, techniques and quality management tools in hard TQM factors. According to Dale, soft factors are human resources management and change in corporate culture. According to Rahman (2004), soft TQM factors have two roles: first, they create an environment in which the implementation of the hard factors of TQM is possible and second, they influence performance the way human resources management influence an organisation.

Quality culture refers to organisational culture in which values, norms and basic assumptions support the holistic production of quality and continuous development of operations. When a customer-based way of thinking and operating that embraces the multifaceted nature of quality is deeply rooted in organisational culture, the organisation can be considered to have an active quality culture. (Silen 1998) The level of quality management in an organisation is described using maturity models and organisations can be divided into different categories on the basis of how well quality values and principles have been integrated in the organisational culture. For example, Dale (1999) classifies organisations into six different quality management maturity levels: uncommitted, drifters, tool pushers, improvers, award winners and world class (see Dale *et al.* 1994). Dale (1999) states that classification is useful when defining the quality

management maturity level of organisations and when interpreting the views of people working in different organisational levels. The classification is also a useful tool in the planning of the future.

The long-term goal in TQM is to maintain and improve competitiveness (Silen 1998). Quality is a multifaceted and relative concept, and it may be difficult to perceive. A correct and extensive view on quality cannot be achieved if it is only examined from one perspective (Lillrank 1998, Beckford 1998). Lillrank (1998) divides quality into six different components: production, product, value, competition, customer and society-based quality. Silen (1998) introduces the notion of operational quality, which refers to the efficient and fault-free processes of an organisation, that is, its ability to achieve the quality seen from different perspectives.

The leading European and global companies followed the principles of TQM as early as the 1980's. According to Williams *et al.* (2006a), Six Sigma and the Lean approach complemented TQM in the 1980's. The main quality development methods used in Finland in the 1980's and 1990's were the ISO 9000 quality management standards and quality award criteria. Of these, quality management systems passed their culmination period at the end of the 1990's, and their importance in business started to decrease. The most advanced companies started to create competitiveness assessment models tailored to meet their own needs and to be used in conjunction with quality award systems. (Silen 2001) The metal cluster's approach to quality focussed, for a long time, on quality control, with them only starting to discover all-inclusive quality management in the 1990's. The level of quality systems was then clearly exceeded in terms of quality culture. (Silen 1998)

During the end of last decade, TQM was, in practise, seen as a 'chant' which solved all problems and answered to all questions. However, it failed to meet all high expectations (see e.g. Yong and Wilkinson 2001, Haapasalo & Kess 2001). Partially, this was caused by the misunderstanding in the content and practise of TQM, but it was mainly caused by the immature capability to apply and utilise TQM. Simple and easily perceivable quick wins in the early phases of TQM led many to erroneously think that the whole process of applying TQM would be easy and that it would fix all. In a way, this is sad, because Deming (1986) and others already warned about the huge amount of work required in implementing TQM (see e.g. Douglas & Frienddall 2004). Management models and their ability to support quality development can be evaluated in a number of ways and

also, evidence of positive correlation on performance and efficiency has been shown (see e.g. Wilson & Collier 2000, Douglas & Friendendall 2004).

Quality management systems are intended to be formal systems for organisations to manage the quality of their products and services. Quality management system is a framework, the integral parts of which are the management's responsibility, resource management, measurement and continuous improvement. Its objective is to ensure that processes are carried out the same way every time in such a way that the right kind of information, procedures, skills and management is used. It helps to define requirements, communicate policies and operating measures and to improve team work. (Beckford 1998, Dale 1999) Thanks to quality management systems, the definition of clear requirements, communication of policies and procedures, and strengthening teamwork become easier. Quality audits and reviews must be carried out on a regular basis to verify the successful application of management systems. The ISO 9000 series is by far the best known internationally used quality management standard, which has been developed over a long period of time. The primary objective of the series is to assure buyers and other interest groups of the quality of the said products or services. (Dale 1999)

According to the ISO 9001 quality management system, an organisation: defines the operations that need to be considered when applying the system. The first task is to describe operations related to products. The requirements set in the other four sections – quality management systems; responsibility of the management; resource management; and measurement, analysis and improvement – are applicable to all organisations and their main task is to describe in the quality manual or other documentation system of an organisation how they can be applied in the organisation in question. These five sections define the tasks that should be consistently carried out by an organisation in order to meet legislative and customers' requirements. (SFS EN ISO 2008)

The ISO 9000 series adheres to the eight universal quality management principles that organisations can utilise in order to improve their performance. The objective of these principles, created on the basis of know-how and experience of internationally renowned experts, is to help the user organisations to obtain continuous success. The aforementioned principles are: customer orientedness – organisations are dependent on their customers; leadership – leaders define the purpose and direction of an organisation; participation of the personnel – the personnel is the greatest resource of any company; process-based operating model – process-based management of resources allows better access to

the goals set; systematic management – improves the efficiency and importance of an organisation and helps to achieve set goals; continuous improvement – continuous improvement of overall performance should be the permanent goal of every organisation; decision-making based on facts – efficient decisions are based on the analysis of data and information; mutually beneficial business relationships – increase the ability of both parties to create added value. (SFS EN ISO 9001 2008)

The first-generation quality standard ISO 9000:1987 and the second-generation quality standard ISO 9000:1994, published in 1994, faced fierce criticism. They heavily emphasised the importance of documentation at all stages, they were strongly directed towards the manufacturing industry, they failed to take the customers' viewpoint sufficiently into account, and they emphasised – perhaps too much so – quality control instead of quality management. (Voutilainen *et al.* 2001) The ISO 9000 standard was developed throughout the 1990s. The quality award models and their criteria accelerated the development of the third generation ISO 9000 standard, which was published in 2000. The standard was updated to better incorporate customer-based operations and continuous development into the ISO 9000:2000 standard. The standard was based on the overall image of the organisation, instead of the previous emphasis on production, operations and quality control. The standard does not explicitly include the aspects of environmental management or the views of occupational health and safety, financial administration or risk management systems; however, it enables the integration of these systems. (SFS EN ISO 9001 2000, Jørgensen *et al.* 2006)

The new version also took the assessment of results and efficiency into account, which had already been the practice in the existing quality award models. Efficient operations, which can be evaluated in terms of customer satisfaction and the competitiveness of the organisation, serve as the basis to the ISO 9000:2000 standard. (Conti 2002) On the other hand, Conti (2004) also foresaw that the new ISO 9000 version would also not be a great success, because its new contents (customer-oriented operations, process approach, continuous improvement) are difficult to implement and assess. The new version requires more investment from the organisations in order to yield any benefits. All organisations do not have the resources or willingness to allocate resources to continuous investments, which means that they risk merely meeting the requirements of the standard instead of actually taking advantage of it. Therefore, there is great variation in the quality levels of the organisations that have been granted the new standard, which

compromises the value of the standard in the eyes of an external auditor, customer or other interest group. The International Organization for Standardization (ISO) published a new version of the quality management systems standard ISO 9001 on 15 November 2008. There were, in practice, no new requirements. The update introduced a content that was rewritten and clarified on the basis of feedback and experiences gained during the eight years of application of the standard (SFS EN ISO 9001 2008).

Even though the ISO 9000 standard series has become hugely popular in the corporate world, it has also been criticised. Criticism has been directed at the excessive importance given to certification and the facility of obtaining a certificate. It is possible to obtain a certificate even though the organisation's system would not, in practice, meet the requirements of the standard. It is easy to build and plan the system on paper but much more difficult to implement it in the grassroots level operations of the organisation. Problems are often highlighted when assessing different systems because it is impossible to get a comprehensive view of the practical operations of an organisation in a one-day audit made by an external auditor. Standards have also been criticised since they may stagnate the operations of an organisation and its ability to produce quality, in addition to which standards may seem like an incoherent collection of a wide range of documents that are often updated. (Viheriäranta 2002)

Wilkinson and Dale (1999) have studied the impact of the atmosphere at work of an organisation on the utilisation of the ISO 9000-standard. If the entire personnel cannot be convinced to support the certification process, the standard is only obtained for the mere sake of getting a certificate – instead of using it as a tool for genuine development work to gain additional advantages. Martinez-Costa and Martinez-Lorente (2003) present the same question of motivation in their study on the impacts of the ISO 9000 certificate. Since the requirement to carry out the certification process is often dictated from outside an organisation, one could assume that obtaining the certificate would enhance the image of the organisation in the eyes of an outsider. The aforementioned study examined this hypothesis by monitoring the development of price on the stock exchange after a company announces it has been granted the certificate. They noted, however, that no statistically significant correlation could be found. According to Conti (2002), inadequate evaluation is the main reason for the unsuccessful implementation of the first 1987 and 1994 versions of the ISO 9000 standard. When organisations were assessed on the basis of the ISO 9000 standard, the assessment focused too much on mere compliance with the standard. Results and efficiency – that should

be the advantages of standardisation – were not assessed. Nevertheless, it must be noted that standards bring harmony and order in organisations, which facilitates operations and decreases the person-based operations, the so-called tacit knowledge. (see e.g. Sun *et al.* 2004).

According to Piskar and Dolinsek (2006) it is important that the management analyses and recognises the existing status of an organisation, finds out what to expect of the standard and when it must be certified. It is also important to commit as much personnel as possible from the early stages of standard implementation. Piskar and Dolinsek (2006) also emphasise that the standard must be obtained for the entire company, not just one section or division. It is also beneficial to use external specialists in the early stages of the process. Managers and supervisors should reward employees for their work in improving the company's quality issues. The managers also play a key role when observing standards. They must participate in the process from the very beginning and hold updated reviews that are both planned and documented in writing. Their most important task is to set an example for their employees. This is the best way to commit employees to the process and it will also enhance trust between supervisors and employees. (Piskar & Dolinsek 2006)

The study of Zeng *et al.* (2007) focussed on Chinese industrial companies. According to the study, the greatest obstacles on the way to the efficient implementation of the ISO 9001 standard were: short-sighted operations, overrated expectations towards the standard, binding commitments and following other companies (trends). According to Zeng *et al.* (2007), the greatest challenges for efficient audits were the lack of commitment of some auditors, too fierce competition between auditors and the all-inclusive service packages provided by certain consulting companies.

Many companies only wish to obtain the certificate and hold their market share instead of genuinely aiming at the integration of quality management brought by certification in the entire organisation. Some members of senior management have too high expectations on the standard. They are enthusiastic about its benefits such as increased profitability, efficiency, market share and quality of end products. At the same time, however, they ignore all the problems arising in the process and trust that the certificate will resolve all. The senior management that is responsible for managing the ISO 9001 standard may not be aware of the plans and goals incorporated in the certificate but merely wish to follow the path set by other companies. (Zeng *et al.* 2007)

According to Longbottom *et al.* (2006), the literature presents the following issues that, among others, hamper the successful implementation of TQM: inadequate knowledge and skills on the strategic and operative level; inadequate connection between quality improvement programmes and strategies, market and operative production; inadequate use of available tools, such as self-assessments; underestimation of the time and resources needed; and failure to develop appropriate performance metrics. In addition, the empirical study of Longbottom *et al.* (2006) indicates that insufficient attention is paid to best practices in the following categories: leadership, human resources management, operating methods and strategies, and resources. When measuring process management and performance, too much attention is paid to monitoring which, as such, does not generate any added value.

Sandholm (2005) pertains that organisations should learn how to use quality techniques in the right way and not just chase every new invention in the market. According to Sandholm, many organisations erred when they use one tool for a certain period of time with very little result and never analysed what kinds of methods would really be needed. Tari's (2005) study identifies factors that are necessary for the successful implementation of TQM from the literature. According to Tari, the implementation and integration of the following issues (Table 6) give TQM a chance to be more than just a passing fad.

Table 6. Factors affecting the successful implementation of TQM. (Tari 2005, published by permission of Emerald Group Publishing Limited).

Critical factors	Means (practices, tools, techniques)
Customer-based approach	Channels for processing customer complaints Identifying customers' needs (surveys, market investigation, reports from vendors) Customer satisfaction survey After-sales service
Management commitment and leadership	Top management commitment Quality council Support improvement activities
Quality planning	Mission/vision statement Quality policy Quality goals Business plan Communication strategies Control and improve of plans

Critical factors	Means (practices, tools, techniques)
Management based on facts	Quality audit Employee performance evaluation Employee satisfaction evaluation Business evaluation Quality costs Use of indicators
Continuous improvement	PDCA cycle Self-assessments activities (ISO 9000, EFQM model...) Seven quality control tools Other tools Techniques
Human resources management	Information communication Suggestion systems Work teams Recognition and reward systems
Training	Individual training plan Training for job requirements General training program
Work teams	Cross-functional teams Quality circles
Communication systems	Bottom–up, top–down, horizontal communication among all the staff Work information Poster Slogan Personal letters
Learning	Continuous training and education
Process management	Quality manual, quality system procedures and work instructions ISO 9001 certificate
Co-operation with suppliers	Supplier audits, evaluation and training Agreed quality
Organisational awareness and concern for the social and environmental context	Environmental manual Environmental system procedures ISO 14001 certificate

According to Rahman (2004), a number of studies that examined the correlation between certain key TQM elements and the success of organisations indicate that only some soft factors of TQM correlate with corporate success. The most important factors affecting corporate success were the commitment of senior management, open organisation, training of employee, participation and

authorisation. Rahman (2004) also states that some studies found that statistical quality control, benchmarking and flexible production systems has no or little impact on corporate performance. According to Rahman, the results contradicted the literature where the hard factors of TQM are considered to have a direct impact on corporate performance.

According to Hannukainen *et al.* (2006), the Quality 2020 survey, carried out by the American Society for Quality, made the following observations the application of quality thinking must become more innovative, flexible and faster to implement. This observation corresponds well with the changes in operating environments: the number of quality professionals may decrease but the need for quality expertise will not. The trend is in line with the decreasing importance of the separate role of a quality department: quality should be made everyone's business. Quality professionals now face the challenge of how to develop alongside developing business and technical requirements.

Williams *et al.* (2006a) use the concepts of traditional or classical quality management and new quality management. They consider classical quality management to consist of issues ranging from inspection to strategic quality management content. The objectives are to reduce the number of inspections, defects, poor-quality products and variation in routine processes. The changing operating environment has, however, proven to be challenging for classical quality management. Rapidly changing, unforeseeable situations have led to the creation of new quality management, which aims at better connections and smooth co-operation with both ends of the value chain.

According to Williams *et al.* (2004), new quality management does not focus on decreasing variation as much as classical quality management. Instead, it is more focussed on facing any occurring situations of crisis. Changes in the operating environment have also posed another difficulty for quality management: it has become increasingly difficult to measure factors related to long-term employment, the impacts of soft non-technological factors on customer satisfaction, increasing importance of software as a part of the product as well as closer co-operation between internal and external operations. The current problem is that appropriate metrics have not yet been developed for the aforementioned issues. Williams *et al.* (2006b) also state that today, when measuring interest group satisfaction, the metrics used can no longer be the immediate quality of the product; instead, overall product quality during their entire service life must be used.

Williams *et al.* (2006a) note that it is now more difficult to make and control improvements than before. Time and speed are important and delays caused by poor quality present a major operational risk. Innovation must be launched in the right markets at the right time. The production of poor quality must be avoided because it may negatively affect the brand of the company and lead to worsening corporate image. The key factors in problem prevention are speed and accuracy, which requires lowering the decision-making threshold and co-operation across the boundaries of different operational units and functions. If mistakes are made, they must be speedily corrected.

2.5 The approach and framework of integrated ESSQ management system

The system is an entity that functions in compliance with certain principles. Systems can be divided into natural and artificial, e.g. manmade, systems. Systems can also be divided into functional and abstract systems. Manmade systems usually have a goal or goals, which means that they are goal-oriented purposeful systems. Natural systems are not considered to have a similar goal. A system is a basic concept of the systems theory and an approach. A system is defined by separating it from its environments, which may also consist of systems. A system can also be internally divided into subsystems. An open system interacts with some of the elements of its environment, whereas a closed system is isolated from its environment. Systems theory can be defined as a group of concepts and methods that can be used for the analysis, planning and management of different systems. The theory is based on the use of mathematical models, which describe the cause-consequence relations and interaction between variables in a system. From the viewpoint of the systems theory, organisations are social units that consist of sub-systems, which are built and rebuilt in order to meet the goals set. The nature of the operations of an organisation depends on the interaction between different subsystems and between the system and the environment. (Conti 2006)

Organisations have a constant need to continuously develop their operations, competitiveness and efficiency; hence, there is a need for systems approach. Different management systems provide organisations with an operating framework and procedure, in addition to which they support continuous improvement. Different quality, environmental and safety standards can be used as the foundation of a management system. Even though the standards are rather

recent, they have been intensively developed. (Seghezzi 2001, Voutilainen *et al.* 2001)

From the viewpoint of the systems approach, TQM does not offer ‘quick fixes’ to problems and it does not contain a specific tool or technique that could be used as a solution to all. Organisations should have a ‘roadmap’ of tools that are suitable for different situations and their use should be a part of daily routine. (Dale & Mcquater 1998) According to Tuominen & Lillrank (2000), the most commonly used tools in Finnish companies are continuous improvement/initiatives, the ISO 9000 quality standards and team work. The first two tools were used in over half of the companies studied. It was also interesting that, according to the study, most tools were used in the metal and the electronics industries.

Currently, there is no widely accepted standard for integrated management systems that would be equivalent to the ISO standards. The different integration levels in organisations make the creation of a universal standard challenging. (Jørgensen *et al.* 2006) The most commonly used integrated management systems are quality, environmental and occupational health and safety management systems. They are often based on widely used standards such as ISO 9001, ISO 14001 and OHSAS 18001 –standards that include common characteristics and starting points and are thus relatively easy to integrate. (Wilkinson & Dale 1999, Shaw 2003, Jørgensen *et al.* 2006, Zeng *et al.* 2007)

The world around us consists of a variety of different systems that are either natural or manmade. These systems interact either directly or indirectly, consciously or regardless of our will. Such interaction creates a system, which may consist of several subsystems operating within it. Systems approach has gained ground, because it is commonly seen as combining different scientific disciplines and factors that were previously considered independent. In addition, we have commenced to perceive quality, as well as other fields of management, from the viewpoint of systems approach. This serves as a basis for the creation of integrated management systems. (Conti 2006)

Conti (2006) has identified the relations of an organisation and its both internal and external components, systems and processes (Fig. 9). According to his model, an organisation comprises clusters formed of people or groups. Such clusters interact with other clusters. In the model, arrows indicate the organisation’s goal: the creation of added value both for its interest groups and the organisation itself. Value-generating clusters should therefore play the key role

both in total quality management and the management systems of an organisation in general.

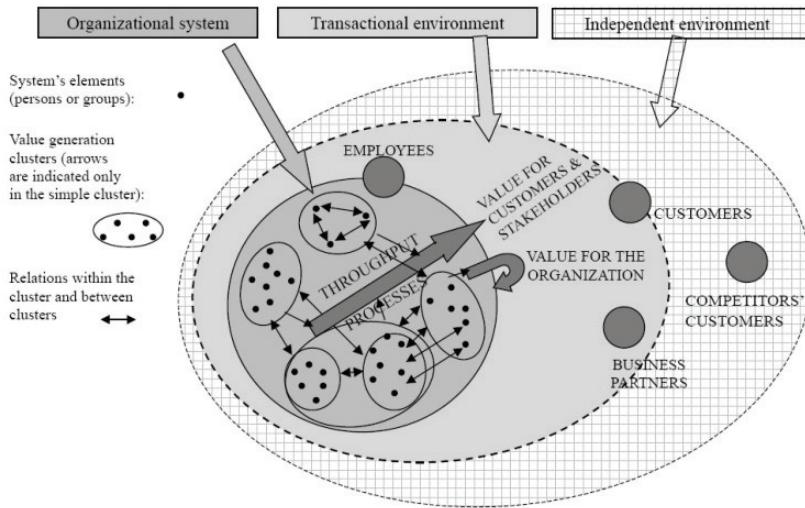


Fig. 9. Interactive organisation model (Conti 2006, published by permission of Emerald Group Publishing Limited).

The model contains no instructions on how to create the added value it contains or even how to create the model itself. However, there are several things that can be done in order to reach the goals indicated in the organisational development model. For example, the models of excellent business management or total quality management such as the European Quality Award (EFQM) or the Malcom Baldrige Quality Award (MBNQA). Whatever the model used, the most critical stage is the clear and accurate description of goals: what are the goals of an organisation and what are the impacts of the organisation and its management system on the surrounding society. (Conti 2006)

The different organisations have very different viewpoints on integration and integrated management systems. There is no common, universal integrated management system; instead, integration must originate from the goals and objectives of the organisation. Organisational culture and atmosphere must support the goals of integration and the willingness to integrate a number of separate management systems. Otherwise integration will remain at the level of mere integration of documentation. (Wilkinson & Dale 2000) Jørgensen *et al.* (2006) also make a remark on the case-by-case nature of integration: there is no one specific way to carry out an integration process and create integrated

management systems. According to Jørgensen *et al.* (2006), the starting point is the organisation's culture and willingness to integrate.

A successful integrated management system requires that all of its elements have been integrated in the organisation as parts its natural operations and culture. Environmental impact management, minimisation of safety risks and quality should be embedded in the everyday operations of a company in such a way that nobody should spend extra time thinking what to do. The operations of an organisation are based on rules that are used to communicate information, train people, and remind them of principles, requirements and good practices that should be adhered to in the organisation. Various documentation and recordings are a large part of the administration of an integrated management system. They have three main tasks: they are used to record incidents and observations, they present future commitments and they can be utilised in the development of products, services and processes. (Voutilainen *et al.* 2001)

There is also an alternative to the integration of management systems: separate management systems can be left as they are, as individual sectors in an organisation. In this case, conflicts and overlapping operations are created between the systems. The organisation will encounter additional costs, unnecessary bureaucracy and increased documentation. The likelihood of mistakes and faults will also increase significantly and overlapping tasks will emerge. To summarise, the simultaneous existence of several different management systems have a negative influence on a number of interest groups, such as employees and customers. When comparing the aforementioned drawbacks of not integrating separate management systems to the benefits of an integrated management system, an increasing number of companies are – little by little – changing to integrated management systems. (Beckmerhagen *et al.* 2003)

The system model of Karapetrovic and Jonker (2003) combines operation-focussed approaches into one management system. (Fig. 10). The model identifies different systems and their primary interest groups: Customers for the quality management system (QMS), Community for the environmental management system (EMS), Employees for occupational health and safety management system (OHSMS), Community and Society for the community and society relationship management system (CSRMS) and Owners for the financial administration system (FMS).

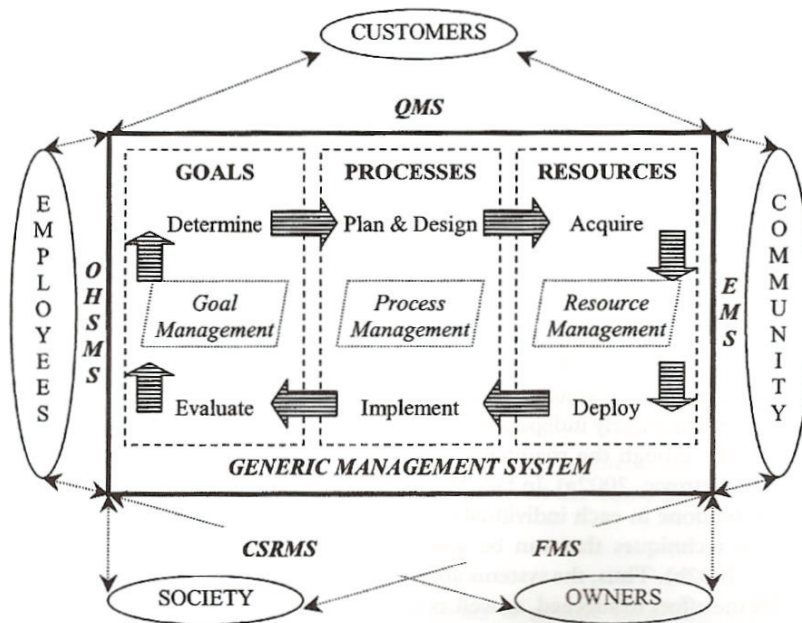


Fig. 10. The operation focussed IMS model (Karapetrovic & Jonker 2003, published by permission of Taylor & Francis Informa UK Ltd).

Deming's PDCA cycle has been illustrated in the centre. The PDCA cycle – together with goals, processes and resources and through a common management system – affects all other systems and hence all interest groups. The model is founded on the idea that systems affecting different things can be, and should be, first joined together and then integrated into an all-inclusive management system. Karapetrovic & Jonker 2003 have studied the models available for the integration of environmental and safety issues.

Wilkinson and Dale have (2001) studied integrated management systems and pointed out that they do not take organisational culture and the 'soft values' into consideration. They have thus formed an integrated management system model (Fig. 11), which is based on the existing and accepted environmental (EMS), safety (OHSMS), and quality (QMS) management systems. The model also aims to take cultural aspects into account.

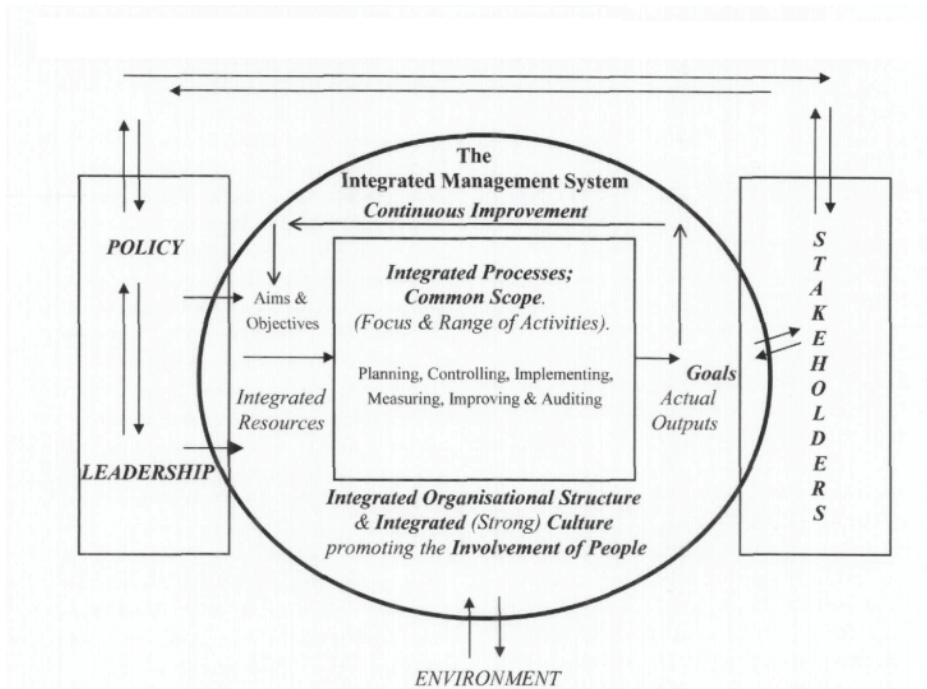


Fig. 11. The IMS model merging existing EMS, OHSMS and EM (Wilkinson & Dale 2001, published by permission of Emerald Group Publishing Limited).

In their model, the integrated quality, environmental and safety management systems have lost their independence and their role is to serve the entity in an integrated way, thus creating added value to the entire organisation. Resources, personnel and processes have been divided between all previous systems. Goals are set and results measured together, which will result into a positive circle of continuous improvement. The model joins all management systems tightly together to form a common integrated management system and cultural structure, which are based on the key aspects of total quality management, such as teams, active participation and co-operation. This way, it is possible to achieve a strong management culture divided between quality, environmental and safety issues. Then, all core values and procedures of an organisation are based on total quality management. (Wilkinson & Dale 2001)

Zeng *et al.* (2007) have studied integration mainly from the point of view of Chinese companies but on the basis of universally applicable theory. As a result, they developed a simple three-level model to describe the integration of management systems. The process commences by combining the ISO 9001

Quality, ISO 14001 Environmental and OHSAS 18001 Occupational Health and Safety, which all divide, among others, Deming’s PDCA (Plan-Do-Check-Act) cycle. The model consists of four levels: strategic synergy, organisational/resources, structural and cultural synergy, and documentation synergy. (Fig. 12)

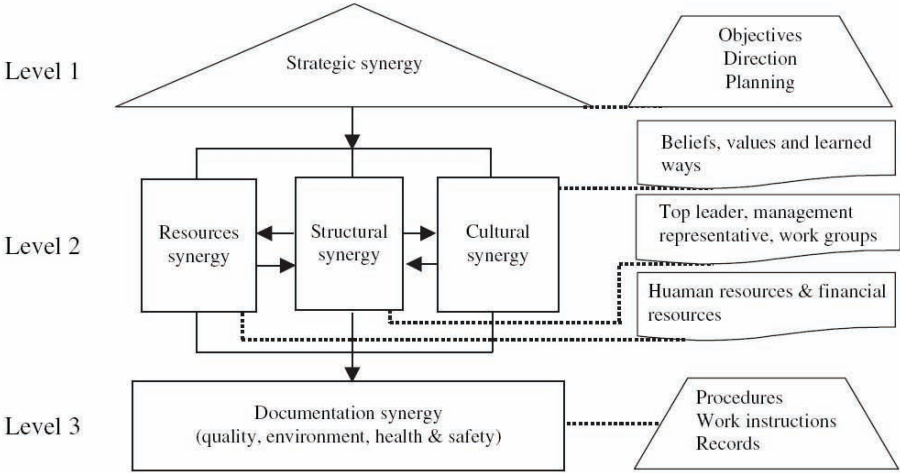


Fig. 12. The three-level IMS model linking ISO 9001, 14001 and OHSAS 18001 (Zeng et al. 2007, published by permission of Elsevier Science & Technology Journals).

The combination of level 1 strategies is the highest and it is also the most important for a successful integration process. If values, politics, strategic planning and goals cannot be combined to cover all integrated management systems, operations often remain purely certificate-driven and they do not genuinely strive for development and the creation of added value. The successful combination of the strategy makes the integration of an organisation at level 2 easier. Traditionally, responsibility for different sectors of an organisation has been allocated to different groups and people. Responsibilities must be better clarified at all levels of the organisation – senior corporate management included – and combined under the same roof. Corporate management must commit to, and participate in, integration, because their involvement is crucial in terms of support to the formation of organisational culture. Level 3, the grassroots-level work, i.e. the combination of documentation, including work instructions, procedures, reporting and monitoring, supports the entire integration process. Documentation

must be based on a defined strategy and policies, and it must cover all integrated areas. (Zeng *et al.* 2007)

One of the objectives of an all-inclusive integrated management system, such as the ESSQ management system, is to manage business through processes. One of the underlying ideas of the process approach is that the best opportunities to increase efficiency are usually when performance of a task is transferred from one department or employee to another. The process approach directly influences structural questions inside an organisation. This will result into a transition from a traditional profit unit organisation towards a matrix organisation and further to a process organisation. (Hamel & Prahalad 1994, Hannus 1993, Virtanen & Wennberg 2007) Quality management is mainly targeted at the development of the quality of the entire process chain instead of a specific part of the chain. Research in processes included in quality management has however been rather limited and the processes have not often been seen as cross-sections of all operations. (Hannus 1994, Virtanen & Wennberg 2007)

Lecklin (2006) describes process management as a way of acting according to which the organisation operates and that is managed through processes. Owners are appointed for processes surpassing unit borders. The owners are responsible for the performance and development of the process in its entirety. On the other hand, Hannus (1994) sees process management as a major reformulation of the way a company operates. In addition to open communication of information and close co-operation, process-based performance goals and metrics play the key role in process management. Process management allows those in charge of processes to have better opportunities to manage and develop operations in a holistic manner. (Hannus 1994, Lecklin 2006)

The integration of operating systems is, almost without exception, challenging, because the best integration method greatly depends on the special characteristics of the organisation in question and therefore there is no general model that could be universally applied. The content of the existing systems that are to be integrated, the field of operation of the organisation, organisational culture and a number of other factors contribute to the successful completion of the integration process. (Wilkinson & Dale 1999, Karapetrovic & Jonker 2003) According to Wilkinson and Dale (1999), standards ISO 9000 and ISO 14001, their combinations, other different aligned standards, integrated core standards with aligned sub-systems or the use of the EFQM model as a tool for integrating all operations of a company, for example, can be used as starting points for integration. Different integration alternatives are compared in Table 7.

Table 7. A comparison of integration models (Wilkinson & Dale 1999, published by permission of John Wiley and Sons).

Model	Scope	Requirements for integration	Objectives	Limitations
ISO9001/14001 - Matrix	As required by each standard.	Harmonization of elements and standards.	Meeting certification requirements of each standard. Reducing audit and admin. costs.	Addition of other standards add to complexity. Linkages open to different interpretations. Ignores culture.
Aligned standards	As required by each standard.	Harmonization of elements and standards.	Meeting certification requirements of each standard. Reducing audit and admin. costs.	Offers potential for the addition of other standards but adds to complexity. Ignores culture.
Integrated core standards with aligned subsystems	Must be same for each 'part' of core. As required by each standard for subsystem.	Harmonization of elements in core. Harmonization of elements and standards in subsystems.	Meeting certification requirements of each standard. Reducing audit and admin. costs.	Core elements must be defined at the outset. Complex. Ignores culture.
Interlinked standards through system approach	As required by each standard.	Harmonization of elements and standards.	Meeting certification requirements of each standard. Offers potential for addition of non certified systems.	Addition of other systems adds to complexity. Ignores culture.
EFQM Model	'Total'; company wide.	Implementation of TQM. 'Harmonization' of approach. Development of IMS models.	Business excellence; improving performance in all areas.	Does not address ISO certification requirements.

According to Karapetrovic and Willborn (1998), integration always leads to an efficient system regardless of the degree of integration. In this case, the system may include, among others: more advanced technology, higher-quality operative

actions, advanced internal leadership and team work, increased motivation of the personnel, decreased costs or increased customer satisfaction and improved corporate image. According to Beckmerhagen *et al.* (2003), the general benefits of an integrated management system include: simplification of the requirements of standards and management systems, decreased audit and registration costs, decreased paperwork, decreased costs related to the interpretation and implementation of standards, harmonised documentation practices for management systems, balanced processes and resources in different areas, a large number of small business advantages, elimination of parallel and overlapping operations and improved efficiency.

Competitive advantages can be obtained if an organisation manages to harmonise and target new operating methods for customers in quality-related management system and on products in environment-related management systems. Thanks to these benefits, synergy is created between quality and environmental issues (as well as safety and security). At the same time, the organisation focuses on continuous improvement and innovation in products. (Jørgensen *et al.* 2006) In their article, Von Ahsen and Funck (2001) state that the benefits of integrated management systems include improved transparency of different sectors and saved time and financial resources. According to Zeng *et al.* (2005), the greatest advantages of integration are: avoiding overlapping procedures, decreased number of conflicts between procedures, and decreased strain on resources. Jørgensen *et al.* (2006) identify the benefits as minimising paperwork and bureaucracy, decreased confusion between standards and simplified internal and external audits. According to Voutilainen *et al.* (2001), internal quality and safety audits should be carried out at the same time, taking advantage of the same method.

According to Beckmerhagen *et al.* (2003), common challenges for integrated management systems include: it is noted that the existing management systems work well and that they should continue to remain separate; doubts about gaining added value if there is no requirement for integrated management systems by customers and competitors; negative experiences in the implementation of management systems and programmes related to, for example, quality; inadequate communication between managers and employees participating in the process; and scepticism by middle management created partly as a consequence of inadequate information.

According to Von Ahsen and Funck (2001), the critical problems of integration are the demanding nature of centralising all resources and complicated

integration process. In addition, conflicts related to goal-setting and conflicting demands by major shareholders may significantly hamper integration. Jørgensen *et al.* (2006) note that one of the risks of integration is in prioritising different management sectors. An organisation may, for example, pay more attention to, and invest more in, quality than environmental issues.

According to Jørgensen *et al.* (2006), commitment to managerial work, employees' motivation and changes in routines and traditions are, among others, amongst the greatest challenges faced by organisations that build integrated management systems and try to establish them as a part of daily operations. According to Dennis (1997), the challenges faced by systems within organisations are great: quality, safety and environmental systems require organisations to greatly increase the speed and volume of communication of information; quality, safety and environmental systems require a great number of concepts to define and categorise complex organisations; leadership skills needed to use and maintain the systems are not yet sufficiently developed and deployed in the organisation; systems face individual suspicions and boundaries set by organisations that must be overcome.

The sectors of EHSQ management – environment, health, safety and quality – have become increasingly important aspects of development and improvement. The actions and requirements of the management sectors are determined by, for example, legislation, business (clients, competitors, investors, cost cutting, risk management) and ethical reasons. In global and complex organisations this requires the systems approach; a framework, which links different sectors together. The systems approach also enables certain consistency in operations, in addition to which it ensures that an organisation can learn from its operations and exploit the results achieved. It also simultaneously creates possibilities and freedom for operations and inspiration. The systems approach has evolved greatly during the last couple of decades, and the latest views truly provide organisations with a good and feasible framework that the companies can utilise in an innovative way for the benefit of their business. (Voutilainen *et al.* 2001)

2.6 ESSQ management and maturity models

Maturity models are tools that are used for analysing and developing the practices of a company. Companies utilise several different maturity models that are suitable for assessing the maturity of different sectors. There is no universally applicable model or a model that could be used for examining the entire ESSQ

entity. Excellent business management quality award models, such as the EFQM Excellence Model and the MBNQA model, are a possible tool for the integration and development of management systems. Their advantages include the integrated linkages between performance and result. Components that enable profit making and that direct all operations from the viewpoint of an organisation can be included in the integrated management system. These components can be used to better integrate separate management systems into one whole. (Karapetrovic & Jonker 2003) According to Wilkinson and Dale (1999) and Dale *et al.* (2000), the advantages of the EFQM model in the implementation of an integrated management system guarantee continuous development and improvement.

The EFQM model is based on the previously widely used other quality award models, namely the US-origin MBNQA and Japanese Deming Prize. (Juran 1999, Tuck 2005) The models are so similar that even EFQM lists the advantages of using the model when describing research results that evaluate organisations that have been awarded either with the Malcom Baldrige Quality Award or the European Quality Award. (EFQM 2003) However, there are some differences between the models. The EFQM model is clearly built on a symbiosis between operations and results: excellent operations create excellent results through innovation and learning. The EFQM model also puts more emphasis on customer-based operations and, in particular, the surrounding society. (Tan 2002, EFQM 2007, Conti 2007)

The EFQM model is a tool that organisations can use for many different purposes. Organisations may use the model as a tool for self-assessment to measure the organisation's position in the path to excellence; the model helps the organisation to understand and discover weaknesses and develop solutions. The model can also be used as a basis for a common language and way of thinking that is used within the organisation across the boundaries of different functions. The EFQM model can also be the framework of the management system of an organisation and set guidelines for initiatives to eliminate overlapping operations and recognise development opportunities. (Sandbrook 2001, EFQM 2007)

Different operators are usually aware of the existence of the EFQM model but there are shortcomings in the understanding and, in particular, utilisation of the model (Wilkes & Dale 1998). Halachmi 1995 and Eriksson's (2004) study indicate, among others, that the biggest problem for companies participating in quality award competitions was that the competition itself took too much attention from development and constant improvement. Culture and

organisational backgrounds thus clearly play a part in the understanding and implementation of the EFQM model, which brings additional challenges in the building of a system which complies with the model. Nevertheless, even though the objective of the EFQM model is not to be strongly directive but merely to give guidelines, it does have an impact on how people perceive leadership and other core elements. (McCarthy & Greatbanks 2006)

According to Zutshi and Sohal (2005), the benefits include saving costs as the number of overlapping operations decrease, more efficient allocation of resources, improved communication and harmonised training of the personnel, among others. In addition, the companies gain deeper understanding of the requirements of their interest groups, clients' trust in the organisation increases, and the corporate image improves. Hendricks and Singhal (1997, 2001) study, which included nearly 600 quality award winners, shows that the financial performance of quality award winners who have successfully implemented TQM was improved compared to the control group (see e.g. Eriksson & Hansson 2003, Eriksson & Garvare 2005).

Russell (2000) has studied the relationship between the EFQM model and new-generation ISO standards and noted that they are similar and mutually supportive. Both have the same systemic basis and they base the development work on Deming's PDCA cycle. There are also significant similarities in terms of content, basic values and evaluation points. Table 8 presents the main characteristics of the ISO 9000:2000 standard and EFQM model, and also illustrates the great degree of similarity between the two alternatives.

Table 8. The underpinning principles of ISO 9000:2000 and the EFQM model (Russell 2000, published by permission of Emerald Group Publishing Limited).

The 8 Principles of ISO 9000:2000	Fundamental Concepts of the EFQM Excellence Model
Customer focus	Customer focus
Leadership	Partnership development
Involvement of people	People development and involvement
Process approach	Management by processes and facts
System approach to management	Continuous learning, innovation and improvement
Continual improvement	Leadership and constancy of purpose
Factual approach to decision making	Public responsibility
Mutually beneficial supplier relationship	Results orientation

Russell (2000) also identifies differences. The EFQM models views partnerships in a more extensive manner and it focuses more on innovation and learning. In addition, public responsibility and results orientation are integral parts of the model. These areas can also be found, at least in part, in the ISO 9000:2000 standard if it is studied more in-depth. According to Russel (2000), ISO 9000 and the EFQM model are not so much competitors of each other but they serve slightly different purposes. The standard is often useful or even necessary step in the path of excellence of the EFQM model. It must be noted, however, that the situation greatly depends on the needs of the organisation in question and the level of its existing management system. When used well, ISO 9000 or other quality management systems steer an organisation towards excellence. When used badly, they undermine all actions made in the pursuit of excellence. Also, if the goal is set to excellence, the requirements of the standard alone are not sufficient but they merely support other, more demanding models.

Laframboise (2002) also came to a similar conclusion. Laframboise's study on Canadian organisations indicates that the greatest benefits from the TQM are gained by organisations that support their standards, for example, ISO 9000, with a more demanding TQM model, such as the quality award models. The implementation of a standard alone does not bring significant benefits to an organisation.

Conti (2004, 2006) has studied total quality management models from the systems perspective. Figure 13 presents Conti's view on the general starting point and basis of TQM models and quality award models. According to Conti (2005, 2007), the TQM models developed in the 1980s that preceded quality award models were mainly checklists to examine whether the TQM practices applied in an organisation matched the views of the person who made the model for total quality management. Conti also participated in the development of the EFQM model on the basis of the previous quality award models. The objective of the EFQM model is to be a tool that can be used in the development of organisations, not merely a checklist for quality control.

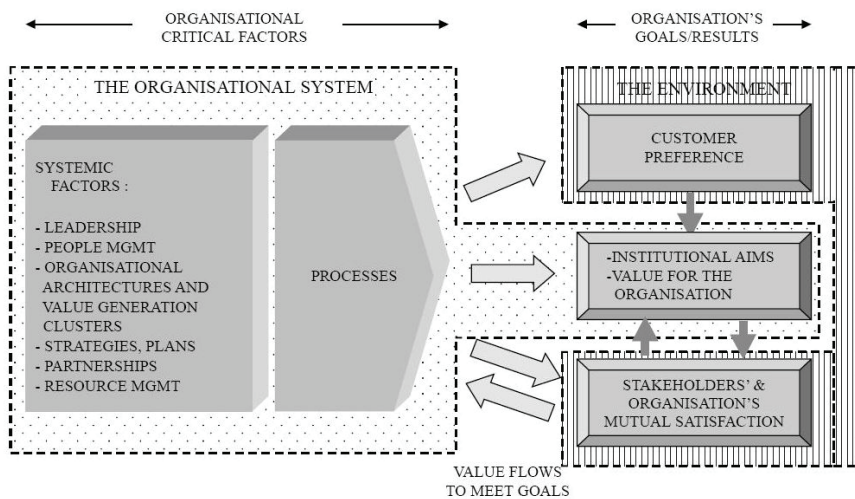


Fig. 13. Conti's description of TQM models (Conti 2006, published by permission of Emerald Group Publishing Limited).

Conti's (2006) description shows the two-faceted structure of quality award models: organisational structure, processes and operating system are placed on the left, whereas results seen from different perspectives are illustrated on the right. The results can be divided into, for example, benefits to the customers and wider benefits for the entire society. The ultimate objective is to achieve mutual satisfaction of stakeholders and the organisation, and therefore increase the value of the organisation and meet its own goals.

When using quality award models, the organisation should be compared with other corresponding organisations and assess the situation on the basis of the comparison. Conti (1997) has also used the quality award model to create a diagnostic tool that can be used for evaluating operations and finding development points. Quality award models usually have a left-to-right approach: the operations of an organisation lead to results. Conti has turned the approach from right to left, which means that the reasons for results are sought after (or problems causing poor results or development points). Figure 14 illustrates Conti's diagnostic self-assessment approach. (Conti 2002)

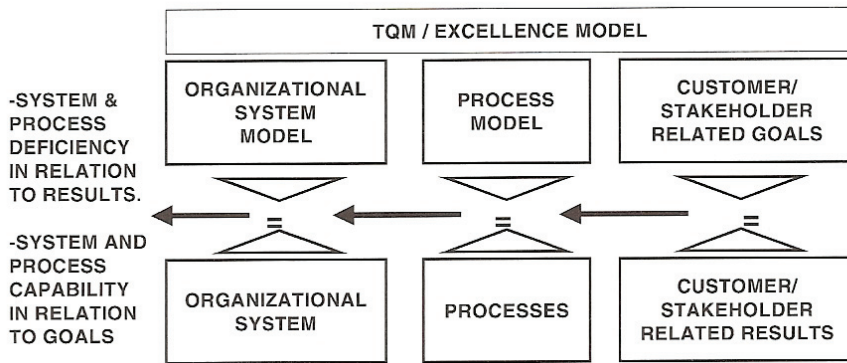


Fig. 14. Conti's diagnostic self-assessment (Conti 2002, published by permission of Taylor & Francis Informa UK Ltd).

There are also several other approaches that can be independently used to assess the strengths of a management system, such as ISO 14031, CMMI, COBIT, PART, Nadcap. The ISO 14031 standard can be used to evaluate environmental performance. CMMI and COBIT are used for assessing the efficiency of management systems in organizations and PART has been used to measure especially public sector performance in the United States of America. Nadcap (formerly NADCAP, the National Aerospace and Defence Contractors Accreditation Program) is a global cooperative standards-setting program for aerospace engineering, defense and related industries (Nadcap 2010).

The assessment of environmental performance is an internal management process and a tool that continuously produces reliable, verifiable data for corporate management. The information gained by applying the standard can be used to identify whether the organisation in question meets the environmental performance requirements set by its management. (ISO 14031 1999, Putnam 2002) The strength of indicators is based on the production of numerical analysis on the development trends in environmental issues and their annual comparisons. When an organisation yearly compares the development of its operations, indicators function as a sort of 'preliminary alarm system' for environmental issues. (Jasch 2000)

According to Nevalainen (2005), when using CMMI, maturity reflects the status achieved by an organisation; its degree of establishment. The higher the maturity level of an organisation the lower the risks and uncertainty in its operations. Higher maturity level means better efficiency and better quality of

products. However, CMMI does not cover all activities that may be relevant for different operators, or explicitly address all function-specific issues e.g. integrated ESSQ Management. Also, since COBIT has a history of being used by information technology auditors, it is in many cases the framework of choice of IT auditors and IT risk managers. The same is true for PART, which was developed to evaluate and improve programme performance in order to allow the US federal government to achieve better results. Nadcap describes for one program to accredit the capability of suppliers furnishing processes, products, and services for the aerospace and defence industries as provided for in specific programs. (see e.g. Ridley *et al.* 2004, Beecham *et al.* 2005, Von Solms 2005, Gottschalk & Solli-Saether 2006, Jokela *et al.* 2006, Mccaffery and Coleman 2007, Frisco & Stalebrink 2008, Nadcap 2010)

3 Research contribution

This chapter 3 presents the individual research contributions of the each research articles (I-V) and research contribution synthesis of the research articles: Development of Environmental Management: a case study of steel production; Evolution of Safety Management and Systems in steel production organization; Critical incidents in the development of Quality Management in steel manufacturer' production; Benchmarking ESSQ Management System through tailored maturity model; The integration of ESSQ Management and quality award models in leading international steel companies. Each research article (I-V) is a separate entity and responds to a defined research question of the said article (RQ 1–5): Article I = RQ 1, Article II = RQ 2, Article III = RQ 3, Article IV = RQ 4 and Article V = RQ 5. Figure 15 illustrates the connections of the five research articles. Research contribution synthesis is based on the consensus of the empirical data obtained during research and the theoretical framework.

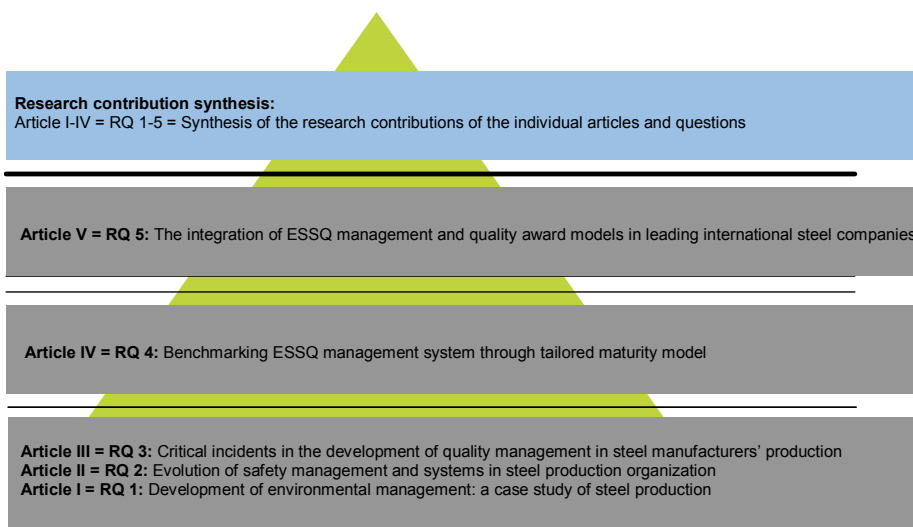


Fig. 15. Connection of the research papers to the integrated ESSQ management.

The historical development of environmental, safety and security, and quality management and the related concepts are separately discussed in order to be able to better explore the background, logic and framework of the integrated systems approach. At the same time, current views on successful environmental, safety

and quality management and their relation to business management can be examined in a more transparent manner. Thus, the implementation of integrated management systems and their advantages and challenges can be better studied. In addition, the study of maturity models both as tools for evaluating the maturity level of an organisation and as business management tools further clarifies the framework, advantages and challenges of integrated management systems.

All research articles (I-V) include an empirical study where the aforementioned aspects have been approached in a concrete manner from the viewpoint of the study subject, always in consideration of theoretical studies and earlier research in the field. The examination of the history, current status and maturity level of ESSQ management in the case company further indicates the development of ESSQ management towards integrated management systems. Benchmarking studies help to map the current status of ESSQ management and maturity level in the case company compared to selected international operators. This will also shed light on the status of integrated management systems and ESSQ management and the target companies' views on the systems approach. Empirical studies will offer a good opportunity to create excellent ESSQ management models for the case company, in addition to the opportunity to understand ESSQ management-related thinking and views as generic business management tools.

3.1 Development of environmental management: a case study of steel production

Environmental management is an environmentally conscious area of business management (Johnson & Walck 2004). *The general development path of environmental management is quite similar in Finland and other parts of the world.* Prior to the 1970's, emission restrictions and environmental regulations were, in many fields of industry, rather undeveloped and polluting was, in practice, a free commodity for industrial enterprises. As environmental regulations developed and tightened in the 1970's, companies were forced to adjust to new restrictions set for emissions and operations. *The Traditional environmental management of the 1970s was the first stage of environmental management* and it is often referred to as *a period of reluctant adaptation to environmental factors.* (Petulla 1987, Kallio 2001)

The second stage of environmental management, the Modern Environmental Management, commenced in the mid 1980s when business life understood that no

organisation could succeed in the long run if their operations were in major conflict with the requirements and values of the surrounding society. Companies were forced to re-assess their attitude towards environmental issues and recognized their strategic potential. The second stage of environmental management is called *passive appraisal of environmental aspects*. (Petulla 1987, Kallio 2001)

At the beginning of the 1990s, only few companies had reached the level of innovative actions in environmental management. Operating principles and methods started to change, however, towards *the end of 1990s* when *environmental management tools* became commonplace, thanks to the introduction of the ISO 14001 standard. It was then acknowledged that a large part of the critical success factors of environmental management were general in nature, and that they could be applied to any organisation regardless of its size, sector or field of business. (Zutshi & Sohal 2004)

In the 2000s, modern environmental management still prevails as the most dominant trend, in particular when *the strategic opportunities of environmental management* became prominent. The development of environmental management tools commenced in the 1990s and in the 2000s, and they have since established their position as *a general part of management practices*. (Kolk & Mauser 2002). Eco-efficiency also emerged as an important issue for companies, and businesses faced increasing pressure from legislation and markets. This, in addition to globalisation, significantly affected the environmental aspects of business. In addition, climate change emerged in the 2000s has become the most significant environmental aspect of business operations, in particular after emission trading, which significantly affects the steel industry was commenced. (Heiskanen 2004)

Traditional environmental management has been strongly directed by legislation, which seemed to have been created in close connection with major environmental hazards or threats. However, modern environmental management aims to be proactive rather than reactive: it emphasises the prevention of problems and the use of environmental management as a positive way to communicate with the society. Environmental management is currently perceived as responsible business carried out taking environmental aspects into consideration and operating in compliance with the principles of sustainable development. It is a widely recognised that companies can gain competitive advantage through environmental management, although this requires innovative measures that exceed the demands of legislation (Johnson & Walck 2004). It must also be noted that no amount of effort, promotion or achievement will create a

perception of environmental excellence, if the trust of the public does not exist (Rice 2003).

The development of environmental management in the case company corresponds to the descriptions and stages presented in the literature. In the 1960s, in the early days of the case company, environmental issues were not considered important by the management. Business operations during the decade can be described as production-oriented: the most important priority was to produce as much steel as possible. Environmental issues were considered mainly when ensuring that business operations complied with the legislation at that time. Environmental management then followed the passive trend prevailing in the 1960s.

In the 1970s, the attitude of the management towards environmental issues slightly improved from the 1960s. New environmental technology for exhaust emission purification was introduced, and the first environmental measurements were carried out. As a result of the energy crises, the consumption of energy declined and heat recovery improved – not for protecting the environment, however, but to save money. In the 1970s, environmental management developed simultaneously with other companies complying with the traditional environmental management. Companies adopted increasingly tight emission and operation restrictions, although they were, in fact, against them.

In the 1980s, the attitudes of the management towards environmental issues further improved from the 1970s. Transition from the treatment of emissions to proactive prevention was a major breakthrough in environmental management. The air protection legislation and waste control forced companies to improve their operations in the 1980s: the number of measurements carried out and environmental awareness in general increased. The case company also drafted a written environmental policy by the end of the 1980s, to follow the general trend in environmental management. Environmental management complied with the principles of the modern environmental management and was mainly on the same level with other general development in the business world, although some major companies were more advanced in environmental issues.

In the 1990s, the ISO14001 standard was enforced and the case company decided to certify all production units. The case company were among the first steel works in Finland and the world to be granted the environmental management certificate and also to implement the EMAS. When striving towards environmental excellence, the importance of empowerment, continuous feedback and review cannot be underestimated. If employees are actively involved in

environmental endeavours, the company's possibility to achieve superior environmental performance is significantly enhanced. (see e.g. Govindarajulu & Daily 2004) The case company was also the leading company in environmental reporting. The emphasis was still heavily on controlling process exhaust emissions, but discussion on eco-competitiveness and life-cycle thinking also commenced. The management, on the average, considered environmental issues important or very important. The case company was *a pioneer in environmental management in terms of e.g. implementation of environmental standardisation and environmental reporting* in the 1990s.

In the 2000s, the case company lost its pioneering position in environmental management: a tactical decision was made not to simultaneously develop all aspects of environmental management. However, the strategic opportunities of environmental issues would still be taken into account in business operations. According Johnson & Walck (2004) companies should integrate sustainability values in particular into their core business values and strategies through integrated management systems, because this was found to be the best possible way to achieve sustainability. *In the 2000s*, environmental management clearly established its position as an integral part of operations of the case company, and a new business area following the principles of the modern environmental management as *the strategic opportunities of environmental management* emerged. The Implementation of environmental processes is complicated, but every attempt should be made to fulfil all of the best practise criteria to ensure success (see e.g. Joseph *et al.* 2008).

The case company's management still considers environmental issues highly important. It must be noted, that the leadership and support of senior management are vital for ensuring organisation-wide awareness and understanding of environmental matters and commitment to the successful implementation of the environmental management system (see e.g. Zutshi & Sohal 2004). The customer-based product-oriented approach and the related eco-efficiency and life-cycle principles are being underlined, but there are still too few practical actions taken. Future global challenges lay in the technological preparedness for future European Union legislation and climate change.

Table 9 shows the CMMI maturity model used for assessing the level of environmental management in the case company. According to the CMMI model, the case company has *passed the level of a 'beginner'* (an organisation that only recently became aware of environmental issues) in any environmental management sector. In order to support eco-competitiveness, the management of

environmental issues must be all-inclusive and cover all operations of an organisation (see e.g. Niskala 1997).

Table 9. Environmental management maturity levels of the case company (Tervonen *et al.* 2010, published by permission of Inderscience Enterprises Ltd).

Management sectors	EHSQ	Production	Sale	Purchase	R&D	Communication
Commitment	Competent	Competent	Not handled	Not handled	Competent	Not handled
Responsibilities	Experts	Experts	Experts	Experts	Experts	Experts
Policy	Competent	Competent	Competent	Competent	Competent	Competent
Impacts	Proficient	Proficient	Competent	Competent	Not handled	Not handled
Targets	Proficient	Proficient	Not handled	Not handled	Not handled	Not handled
Programs	Proficient	Proficient	Not handled	Not handled	Not handled	Proficient
Audits	Competent	Competent	Not handled	Not handled	Not handled	Not handled
Competence	Competent	Competent	Competent	Competent	Competent	Competent

Scale: Expert – Proficient – Competent – Beginner – Not handled

Future operating models were created on the basis of theory and this study: *first; zero development, second; maintain at the current level and third; development of eco-competitiveness*. These models are also the practical findings and implications of the results of this study.

'The zero development' model pushes environmental management in a secondary position in the background, and it is merely considered as a sector of business management. If a company wishes to maintain its level of relative performance, it must constantly develop itself. Therefore, a company's relative level in environmental issues declines in the zero development model. However, today the zero development is no longer applicable in companies, because environmental management is no longer a voluntary choice due to increasing social pressure and legislation. The main reason why many companies resolve on implementing ISO 14001 is their view that this management tool is a *de facto* business requirement (see e.g. Stratchan *et al.* 2003, Wee & Quazi 2005).

'The maintain current status' model indicates that the current status considered to be environmentally sound enough, and the level is maintained through development measures. However, in order to maintain its competitiveness, a company must continuously improve, and therefore the only permanent competitive advantage a company can have is to develop and learn faster than its competitors (see e.g. EFQM & BQC 2000). In the *'maintain current status'* model, the environmental management performance level of a company is likely to

improve, but the competitiveness of a company may deteriorate in comparison to its competitors if the competitors have a faster rate of development.

'*The development of eco-competitiveness*' model aims to remedy faults and it focuses on the development points identified through SWOT analysis and the CMMI maturity model. The model aims at creating eco-competitiveness by utilising the company's current strengths and opportunities and by eliminating threats e.g. risks. In addition, the model considers general trends in environmental management from the viewpoint of EU legislation and globalisation. It must be noted that a number of companies now use environmental issues to improve their market position and to facilitate their entrance in new markets (see e.g. Halkos & Evangelinos 2002).

The model created in indicate that in order to acquire eco-competitiveness the case company should focus more on its environmental strategy, develop environmental calculation, change its environmental system by moving towards the process approach, and to organise needs-based environmental training. In addition, the monitoring of compliance with legislation should be targeted in such a way as to obtain clearer images of the future, in addition to which process and operating instructions and outlines should be made to support environmental policy. A number of studies have concluded that companies should integrate sustainability values into their core business values and strategies through integrated management systems because this is seen as the optimal way to achieve sustainability of operations (see e.g. Johnson & Walck 2004). Using a holistic approach in understanding and recognising the various environmental impacts of the financial decisions made is also recommended. The approach uses scenarios to demonstrate and quantify the environmental impacts of such changes; this will further contribute to the establishment of a more solid basis for the manufacturers's judgements and responses (see e.g. Elhag *et al.* 2008).

According to Silen's (1998) model, the organisation must now explore new ways to further improve its quality culture and consequently its performance. Therefore, rather than merely imitating environmental management tools and techniques, companies should focus on establishing a culture within which these principles can thrive. 'The eco-competitiveness-weighted' model used in this study also incorporates this idea and recommends 'investing' in the creation of a culture, however, never forgetting the existing environmental management tools and techniques. For example, Choudhry *et al.* (2007) show that the development of a positive safety culture can be exploited as an effective tool in improving safety, whereas Milfelner and Snoj (2008) state that there is a moderate positive

correlation between innovation resources and each of the dimensions of financial and market performance of the case companies. They therefore conclude that managers in companies should pay more attention to the development of innovation culture as an important resource.

3.2 Evolution of safety management and systems in steel production organization

Safety Management means the protection of people, environment and property as well as consistent and goal-oriented development of safety (Naumanen & Rouhiainen 2006, Leppänen 2006). *The development of safety management has mainly been promoted by national legislation and regulations.* Several levels can, however, be identified in the overall development of safety management. *Reason's (1997) classification* describes the general development levels of safety management as *people, machine or equipment and organisation.* The level of safety and its content also indicate the complex nature of the concept.

The first level focuses on people and their safety at work. *The second level* adds machine and equipment into the safety concept, which expands the concept of safety to also include connections between people and machines. *At the third level* – organisational level, error or mistake is seen as a consequence of fault existing somewhere in the system. The organisational model has common points with TQM and it underlines the importance of anticipation and continuous improvement of the system. The improvement of both quality and safety will allow the organisation to reach a higher level of risk prevention, which creates a good starting point for an integrated management model. A number of authors (e.g. Herrero *et al.* 2002) are in favour of the idea that the concepts of TQM can be applied to safety practices. The links between safety management systems and quality and environmental management systems can also be found in the existing standards and instructions, such as BS 8800, ISO 9001 and 14001. (Kuusisto 2000)

Corporate safety means the all-inclusive, holistic management of all safety issues of a company (Kerko 2001). In Finland, the Board of Corporate Security categorises *corporate safety* into ten categories: *personnel safety, rescue operations, safety against crime, data security, safety of buildings and premises, safety of production and operations, occupational safety, safety of non-domestic operations, readiness planning and environmental safety* (YTNK 2005). However, there is considerable variation in operating cultures in different sectors and

legislation usually only governs the safety regulations of a single sector. The development of the sectors of safety management has therefore been strongly linked with the development of national legislation. *In Finland, the development of safety management has mainly been driven by the legislation and regulations.* This makes the successful implementation of corporate safety policy challenging.

The development of safety also follows the development of legislation and regulations. In this case, organisational development is passive, since it is dictated from the outside of the organisation by regulators and government. According to Hale *et al.* (1997), safety management focuses on regulations, responsibilities, hierarchy of an organisation, plans and policies. Only *in recent years* development has resulted in a more active approach within an organisation from its own origins. The measurement of a *safety culture* is categorised under *the proactive approach* of safety performance (see e.g. Afrazeh & Bartsch 2007, Choudhry *et al.* 2007).

The development of safety management in the case company complies with the descriptions and mapping indicated in the literature. At the beginning of the case company's business in the 1960's and 1970's, the focal areas were occupational safety, rescue operations and readiness planning. In other words, attention was mainly paid to single risk factors and reactions – consequences rather than causes.

In the 1980's, emphasis was still on labour protection, which basically meant the physical protection of employees from dangers. Environmental safety and mental wellbeing of employees were increasingly taken into account at the end of the 1980's. Legislation and the business of the case company remained rather unchanged compared to the previous decades. *Reason's (1997) safety management model from the human perspective* well describes the development path of safety management in the case company *until the 1980's*. There were two ways to work: the safe way or the unsafe way. People had to make choices concerning their own behaviour. In addition, corporate safety organisations played a key role, and corporate safety was, to some extent, measured by means of accident frequency.

In the 1990's, quality and environmental issues were developed separately due to the separate certification system for quality and environmental issues. This also raised the awareness of safety issues. Labour safety in particular was significantly developed, and the approaches of zero accidents and ability to work gained ground. Moreover, investments were made in rescue services, data security had to be developed due to the increasing number of computers and increasing

consideration was given to safeguarding and access control. Legislation in the fields of rescue services, safety of production and operations, occupational safety, readiness planning and environmental safety also evolved. Access control, guarding and data security were developed independently from legislation, and labour safety exceeded the minimum legislative requirements. *Reason's (1997) model of the safety management of equipment and machines* describes the 1990's well: organisations started to carry out risk analyses, which resulted in increasing attention to the impacts of the working environment on the employee.

Investments in the various sectors of corporate safety increased in the 2000's, but the focus still remained on labour and environmental safety. Legislation was drafted to regulate e.g. health and safety, data security, safety of premises and readiness planning, which resulted in increasing interest in the said sectors. There was no separate legislation on the safety of human beings, criminal and non-domestic actions. These sectors were considered the weakest in the case company. Safety development commenced on the voluntary basis and people were no longer satisfied with merely meeting the minimum requirements. Laws and regulations developed rather together with the development of safety procedures than prior to them. Due to the more complex nature of safety problems, regulations increasingly focussed on prevention instead of giving detailed orders. *Reason's (1997) model of the organisational perspective of safety management* describes safety operations and their goals in the 2000's in the light of similarities in the development of quality management systems and preventive actions.

The development of safety management in the case company in general was mainly striven by legislation and regulations by the authorities. This is the main reason for the separate development processes of the different sectors of corporate safety (see e.g. Kerko 2001, Naumanen & Rouhiainen 2006). Moreover, safety management systems became reactive but no proactive utilisation occurred. A more holistic management of safety issues can be achieved by promoting co-operation amongst those who are responsible for different sectors of safety. (see e.g. Hill & Smith 1995, Lanne 2004) Safety management in the case company has, in the recent years, been integrated into other management systems, such as quality and environmental management systems. Safety Management has therefore become closer to risk management. The improvement of environmental, quality and safety will result in a higher level of risk prevention which, in turn, creates a sound basis for an integrated management model. (see e.g. Honkasalo 2000, Herrero et al. 2002)

The corporate safety management maturity levels in the case company were evaluated in compliance with the CMMI maturity model, and the results are indicated Table 10. The level values of the matrix do not only describe the maturity value of the sector but also the development stage of safety thinking and culture in the company in general. Good corporate culture is the result of good human resources management and efficient safety management (see e.g. Kerko 2001).

Table 10. The maturity levels of corporate safety management in the case company.

Corporate safety sector	Strategies Policies	Processes	Organisation People	Management's decision making information	Methodologies Methods	IT systems Data
Personnel	Below level	Below level	Below level	Initial	Below level	Below level
Rescue	Defined	Defined	Defined	Defined	Defined	Repeatable
Crime	Below level	Below level	Below level	Initial	Below level	Below level
Data	Managed	Initial	Below level	Managed	Initial	Repeatable
Premises	Below level	Initial	Below level	Initial	Initial	Below level
Operations	Defined	Repeatable	Repeatable	Defined	Defined	Repeatable
Work	Optimizing	Optimizing	Managed	Optimizing	Optimizing	Managed
Non-domestic operations	Below level	Below level	Below level	Initial	Below level	Below level
Readiness planning	Defined	Repeatable	Repeatable	Initial	Repeatable	Initial
Environment	Optimizing	Optimizing	Managed	Managed	Optimizing	Managed
Scale:	Optimizing	Managed	Defined	Repeatable	Initial	Below the level

'The future operating models for safety management' in the case company were created on the basis of applicable theory and this study. These models also serve as the practical findings and implications of the results of this study.

The strongest corporate safety sectors in the case company are occupational safety and environmental safety. Personnel safety, crime safety, safety of premises and non-domestic operations were found to be the weakest corporate safety sectors. When assessing or developing operating models, increasing attention should be paid to the correlation between risks and benefits. This way, it would be possible to define the correct order of priority for development points. According to Reason's (1997) model, the more a company faces high-hazard ventures the

more it should invest in protection. In order to be effective, however, full commitment from the part of the highest levels of the management is required – management must assume responsibility for problems and be a part of the solution. (Hill & Smith 1995)

The development of various other fields of safety management will be easier after *the 'development of a corporate safety management system'* because other operating models presented are, in principle, created simultaneously with the management system. Safety management systems modelling is considered as a set of problem solving activities at different levels of abstraction and in all phases of the life cycle of the system. Safety Management System also indicates the inputs, resources, criteria and constraints necessary to produce the required outputs. In addition, risks are depicted as deviations from normal or desired processes. (see e.g. Hale *et al.* 1997)

'*Safety attitudes and culture*' are the second best option – directly after safety management system – when measured in the number and quality of benefits created. Safety attitudes and culture have significant influence on all safety-related actions for which they also create a basis (see e.g. Afrazeh & Bartsch 2007). According to Choudhry *et al.* (2007), research in safety culture is often considered to have an impact on the employees' attitudes and behaviour towards the ongoing health and safety performance of an organisation.

3.3 Critical incidents in the development of quality management in steel manufacturers' production

The development of quality management is often described in the literature as a four-stage process: *the first stage, Inspection (I)* can be considered to have started during industrialisation and mass production. *The second stage, Quality Control (QC)* developed simultaneously with the wartime industries. The second stage emphasised the manufacturing process, which was systematically developed. *The third stage, Quality Assurance (QA)*, incorporates the entire development and manufacturing process of a product as a factor-affecting quality. *In the fourth stage, TQM*, quality is seen in an all-inclusive and strategic manner. The responsibility for quality was, at this point, extended to cover all members of an organisation. The role played by the corporate management also became central (Bounds *et al.* 1994, Dale, 1999, Hannukainen *et al.* 2006). The level of quality management of an organisation can be identified using *maturity models*, and organisations can be categorised into different groups based on their level or

assimilation of quality-related values and principles in the organisational culture (see e.g. Silen 1998, Dale 1999, Jokinen 2004).

The development of quality management in Finland does comply with the description and route mapping presented in the literature, but only at a later stage (see e.g. MET 1986). The principles of quality management were first introduced in Finland only at the end of the 1970's. Development was commenced thanks to the companies' own interest in developing quality and the demand by foreign customers. In the 1980's and 1990's, the main quality development methods in Finland were the ISO 9000 quality management standards and quality award criteria based on quality management.

According to Silva *et al.* (2005), studies suggest that *TQM* should be *integrated with other Management Systems*. Their study also indicates that, in order to maintain successful business, companies should systematically enhance their ability to face changes and provide their employees with the opportunity to innovate and take risks. The trend seemed to be towards the decreasing importance of the role played by the quality department as a separate unit and increasingly making quality everyone's concern. The challenge for quality specialists was thus to meet the needs of business and technology.

The development of quality management in the case company corresponds to the descriptions and stages presented in the literature. The first unit of the case company was established in the 1960's, when the goal was to launch production and increase the amount produced. The 1970's were a period of strong growth and development: the foundation of metallurgical know-how was created during *the 1970's*. At that time, quality was controlled by tests and *inspection (I)* and several product approvals were obtained for different steel grades. Quality was not, however, considered a competitive factor. The company did have external customers but business could not have been described as being customer-oriented. The concept of internal customers was not recognised, either.

The beginning of the 1980's was the period of *quality control (QC)*. The first IT systems were also introduced. Quality manuals were compiled and, *around the mid-1980's*, the concept of quality started to expand *towards quality assurance (QA)* and TQM. The focus shifted to the development of quality. The objective was to achieve a finished product at once and the idea was to produce quality in the production processes with lower costs.

The case company was an active member of the quality board of the Association of the Finnish Metal Industry (currently the Association of the Finnish Technology Industries), which provided the company with first-hand

information on the development trends in the field of quality. The company was able to cut down its delivery times by 50 percent, thanks to the 'Just On Time' project, and the number of rejects decreased by one-third as a result of a quality campaign carried out. Further information was sought from Japan, where the positive impacts of TQM were already seen in practice, and quality circle activities were commenced. The importance of the external customers increased and the concept of the internal customers was introduced. Corporate management, however, considered quality-related issues mainly as specialist work, and quality was not yet recognised as a competitive advantage. Personnel was slightly more appreciated than in the previous decade.

The case company's quality management moved to the last stage, *total quality management (TQM)*, in Dale's (1999) four-stage model, as early as *in the 1990s*. The 1990's was referred to as the decade of quality. Quality was increasingly considered as everyone's concern and responsibility for quality was shifted to individual production units.

An extensive quality project was carried out and it culminated in the quality award won by one unit. The units certified their quality management systems at the beginning of the decade and their environmental management systems by the end of the decade. The organisation learned how to carry out self-assessments and process approach. Some units launched quality theme days, which were also introduced at the corporate level. The ground was fruitful for quality issues and continuous improvement, because there were no financial resources to make investments. The management was aware of the importance of quality and was interested in it. Customer-oriented operations and tailored manufacture were carried out, even at the expense of the company's own profitability. Internal customership became rather advanced. The importance of the personnel was emphasised; perhaps even too much, one could argue. The examination of (quality) goals from the strategy commenced. There was a slight downward trend in quality management at the end of the decade because of the changes in the organisational structure and large-scale investments.

The beginning of the 2000's brought many issues that were current in the 1990's back to discussion. The case company established its new business structure in 2003, and the reorganisation of quality management was carried out in a somewhat conservative way. The years following the organisational change have mainly seen the adjustment of the old structures to the new business model. Development in systems approach was directed towards a more integrated form in the field of *integrated EHSQ management*. The case company also targeted its

quality management development at *lean-thinking* and *Six Sigma*, in addition to the promotion of *the process approach*.

The level of quality management in the case company was assessed using Dale's (1994) and Silen's maturity levels of quality management (1997). The case company was found to be closes to the level of an 'Improver' organisation (Table 11).

Table 11. Maturity levels of quality management in the case company (modified from Jokinen 2004, published by permission of Acta Universitatis Ouluensis Technica C 200).

The case company	Crosby (1980)	Dale <i>et al.</i> (1994)	Silen (1997)	
			Maturity level	Quality award points
Maturity level	Uncertainty	Uncommitted	Uncommitted	100–250
	Awakening	Drifters	Drifters	150–300
	Enlightment	Tool Pushers	Tool Pushers	250–450
	Wisdom	Improvers	Improvers	450–650
	Certainty	Award Winners	Matured	650–800
		World Class	World Class	800–

According to Sebastianelli and Tamini (2003), five factors preventing a successful TQM can be classified under the following subcategories: 1) insufficient resources in human resources management and development, 2) lack of a quality plan, 3) lack of quality-promoting leadership, 4) insufficient resources for the implementation of TQM and 5) lack of customer-oriented operations. The case company already had good operational methods and procedures for most of the issues listed. A particular development point in the case company will be training in quality development tools and problem recognition techniques. In addition, the case company must seek ways to enhance its quality culture and development suggestions (see e.g. Silen 1998). According to Da Silva *et al.* (2005), studies indicates that in order to remain successful companies must develop their ability to face changes and give their employees an opportunity to present ideas and take risks.

Future operating models were created on the basis of the theory and this study: *The first, the 'Let it be' model; the second, the 'Status Quo' model and the third, the 'Investment' model.* These models are also the practical findings and implications of the results of this study.

The 'Let it be' model, discusses the possibility in which the case company is no longer considered strategically important in the expanding solutions business.

In this case, the development of the case company might not be considered important and the possibilities to externalise steel production or to find a strategic partner would be considered. The 'Let it be' scenario might become interesting if the emphasis on developing quality inside the organisation is not maintained as one of the strategic issues. Of course, quality itself is not the issue; the issue is the results provided through quality. However, in order to maintain its level of relative performance, the organisation must constantly develop. Therefore, the 'Let it be' scenario decreases the relative performance of an organisation.

In the '*Status Quo*' model, the case company's current role remains essentially unchanged and it allows the focus to remain on production. Operations will thus continue as before and the development of quality mainly culminates in the promotion of process approach and continuing Lean thinking and Six Sigma. Process approach, for example, will create benefits in the future when the organisation applies it in a greater extent. Moreover, the Lean and Six Sigma projects will be continued and this will, in places, lead to good results. The harmonisation of the 'way of working' will generate benefits when overlapping operations can be eliminated. The important part, however, is to highlight the role of the customer in order to avoid distancing oneself too much from the customers' perspective. In the 'Status Quo' model, the total quality performance level will probably improve. However, competitiveness in relation to the competitors may decline if the development rate of the competitors is better.

The '*Investment*' model indicates that the role of quality will remain paramount and profound metallurgic expertise is seen as an essential aspect creating innovative business solutions. The 'Investment' model refers to investments made in the establishment of a quality culture, the further strengthening of the case company's strengths and overcoming its weaknesses. As a whole, considerable effort is required from the organisation in the 'Investment' scenario, because a leap from the constant development level to a higher level means a huge increase in development inputs. At this point, according to Silen's (1998) model, the organisation must find ways to develop its quality culture and thus, improve its performance.

The case company has often witnessed enthusiasm when new tools are acquired and later lack of interest when their implementation leaves room for improvement. Ravichandran and Rai (2000) emphasise that a coherent, integrated strategy encompassing the adoption of all identified factors is required, as opposed to the implementation of one tool or management practise. This statement is consistent with Deming's (1986) assertion that system factors

account for a far greater variance in work performance than individual or technology factors. According to Ravichandran and Rai (2000), there is significant correlation between leadership, management infrastructure practises and process level activities. It is essential to materialise synergy by focusing on the links between these elements.

Although some studies indicate that there is a correlation between TQM and company's performance, there is no compelling evidence that TQM caused performance to improve. The studies only indicate that there a positive correlation exists. Powell's (1995) empirical study on TQM as competitive advantage supports the conclusion that TQM can produce economic value for a company, but it is not critical for its success. The successful implementation of TQM depend critically on executive commitment, open organisation and employee empowerment. On the other hand, it was discovered that less success appears upon TQM adopters such as benchmarking, training, flexible manufacturing, process improvement and improved measurement. Also, Longbottom *et al.* (2006), Powell (1995) and Rahman (2004) made the same kind of conclusions in their studies.

This profile significantly differs from those found in existing TQM studies, which focused almost entirely on the TQM tools and techniques. This result is consistent with the resource-based notion of complementary resources, which was also made in this case company study. That is, rather than merely imitating TQM procedures, companies should focus their efforts on creating a culture within which these procedures can thrive. The 'Investment' model – the 'TQM weighted' model – in the case company captures this idea particularly well and suggests 'to invest' in the building of quality culture, however always considering TQM tools and techniques as well.

Also, a survey made by Joyner (2007) found a strong positive correlation between the scope of TQM practices implementation and organisation performance. This study highlights the importance of developing a culture of support to further enhance the performance outcomes of TQM implementation. The implementation of TQM programmes may remain under the optimal level if employees do not feel there the process is not sufficiently acknowledged and supported by the entire organisation and their colleagues. The case company has not yet commenced to change its organisational culture. However, an opportunity to do this might present itself in the coming years when the organisation will face great changes as the large generations retire. (see e.g. Silen 1998, Longbottom *et al.* 2006)

3.4 Benchmarking ESSQ management system through tailored maturity model

One of the requirements of a successful integrated management system is that its different elements have been linked to the natural operations and culture of the organisation. The management of quality and environmental issues, as well as the minimisation of safety risks, should be incorporated in the daily operations so that no one should particularly think what issues are currently being dealt with. Successful operations of an organisation require rules to communicate, educate and remind people of principles, requirement and good practices to be followed within the organisation. (Voutilainen *et al.* 2001)

According to Wilkinson and Dale (2002), the integration of various management systems is rapidly becoming more important for organisations and companies alike, regardless of their size, location or field of industry due to the almost uncontrolled increase in the number of system standards. Organisations are, in general, slowly moving from separate independent operations towards integrated systems.

When building their management systems, companies tend to use standards designed for different sectors, because customer interface and interest groups often require standardised certification. The environmental management system ISO 14001, occupational health and safety assessment series OHSAS 18001 and quality management system ISO 9001 serve as examples of commonly applied standards. Increasing the compatibility of standards offers a good basis for an integrated management system. Organisations must have a general understanding of processes if they wish to move from the basic level to a higher level. It is also important to acknowledge the importance of management at an early stage. In addition, an integrated management system must include general management components: procedures, planning, applying and implementation, remedial measures and audits by the management described in the 'PDCA' cycle. Focussing on processes instead of structures and systems emphasises that modern organisations must operate in an innovative way in their pursuit of continuous improvement. (Jørgensen *et al.* 2006)

ISO 14001, OHSAS 18001 and ISO 9001 are made to be mutually compatible. According to Shaw (2003), as much as 80% of the tasks related to the aforementioned standards are common all of them. According to Jørgensen *et al.* (2006), the recognition of similarities between different components and the ability to combine them increases effectiveness and decreases overlapping

operations found in different systems. (see also Von Ahsen & Funck 2001, Levä 2003, Zeng *et al.* 2005) The existence of several different management systems may also negatively affect many interest groups, for example, employees and clients (Beckmerhagen *et al.* 2003).

According to Dennis (1997), the integration of environmental, safety and quality issues can be justified at three levels: 1) Technological uniformity, which refers to common tools and techniques e.g. the application of quality tools in the development of environmental and safety questions, 2) Structural uniformity: systems referring to the development of one holistic management system for the management of quality, safety and environmental issues and 3) Uniformity of policies the starting point of which are uniform strategic goals in the development of quality, safety and environmental issues.

According to Karapetrovic and Willborn (1998), integration process always results into an efficient system regardless of the level of integration. According to Beckmerhagen *et al.* (2003), general advantages of an integrated management system include: Simplification of the requirements of standards and Management Systems; Decreased audit and registration costs; Decreased paper work; Decreased costs related to the interpretation and implementation of standards; Harmonisation of documentation of Management Systems; Balancing and allocating processes and resources to different operational areas; Several smaller business advantages; Elimination of parallel and overlapping operations and Improved efficiency.

According to Von Ahsen and Funck (2001), the most commonly faced critical problems in integration are the difficulty to centralise an important amount of resources and complicated implementation process. Conflicts related to goal-setting and contradictory demands of major shareholders also significantly hamper integration. According to Jørgensen *et al.* (2006), commitment to management and leadership, motivation and participation of employees, changes to routines and traditions etc. are the greatest challenges faced by organisations when creating their own integrated management systems and putting them into practice.

According to Dennis (1997), organisations also face major challenges: The implementation of environmental, safety and quality management systems required the organisations to significantly increase the speed and volume of their communication of information; Environmental, safety and quality management systems require a great number of concepts to define and analyse complex organisations; Management skills needed for using and maintaining the systems

are not sufficiently developed and deployed across the organisation; Systems face individual prejudices and boundaries set by organisations that they have to cross.

The Toddlergrade maturity model (Fig. 16) describes the maturity levels of the entire ESSQ management framework and its different sectors by means of a four-stage scale (roll-over; crawl, walk and run). The Toddlergrade maturity model defines the maturity level of an organisation always with respect to risk and business environment.

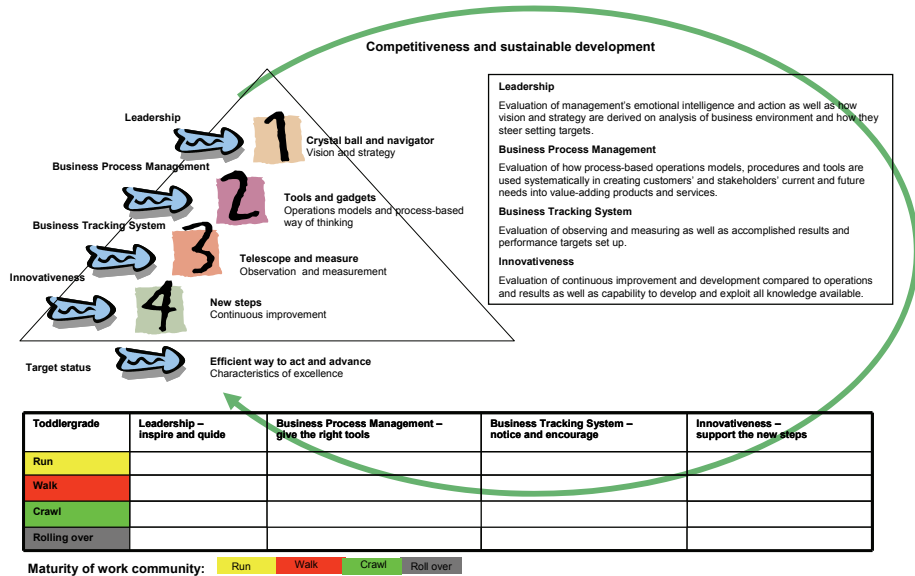


Fig. 16. Toddlergrade – maturity levels of ESSQ management (Tervonen et al. 2009, published by permission of Inderscience Enterprises Ltd).

An organisation at the ‘roll-over’ level is discovering ESSQ issues and is starting to consider the possible linking of the environmental, safety and security, quality sectors. At the ‘crawling’ level, an organisation’s ESSQ specialists are aware of the benefits gained by combining the environmental, safety and security, quality sectors and are also trying to convince corporate management of the matter. At the ‘walk’ level, an organisation’s level is higher than the average ESSQ management in general and the company is doing more than what is required. An organisation at the ‘run’ level is in the forefront of global ESSQ management and leads the way for other organisations.

The Toddlergrade maturity model is simple, transparent and it can be applied to companies of different sizes operating in different fields of industry. It also allows rapid assessment of a company’s maturity level. *Table 12 shows the environmental, safety and security and quality management maturity levels in the case company according to the Toddlergrade model.*

Table 12. The maturity levels of environmental, safety and security and quality management in the case company (Tervonen *et al.* 2009, published by permission of Inderscience Enterprises Ltd).

Maturity model area	Leadership	Steering system	Follow-up systems	Innovativeness
Case company (E)	Crawl	Crawl	Crawl	Crawl
Case company (SS)	Roll over	Roll over	Roll over	Roll over
Case company (Q)	Walk	Crawl	Crawl	Walk
Scale	Run	Walk	Crawl	Roll over

The case company’s *environmental management* is at the ‘*crawl*’ level in all four sectors of the Toddlergrade maturity model. The management’s commitment has been increased thanks to the, for example, energy and climate issues; two hotly debated topics in the media and significant factors in the company’s financial result. Singh *et al.* (2008) state that the current environmental strategies in the steel industry are rather dynamic and depend mainly on the demands of various stakeholders. However, the most important issue is and will be productivity, and consequently the management’s interest mainly lies on the requirements of environmental permits, investments and on ensuring that the operability of the system and completion of required tasks are taken care of.

Safety management is clearly the weakest of the case company’s ESSQ management sectors. All Toddlergrade maturity model sectors are at the ‘*roll-over*’ level. The distribution of responsibilities is a fundamental problem in the case company’s safety management and its operations: people have not been appointed to be sufficiently clearly responsible for safety operations in different sectors, which significantly decreases the level of operations. In addition, the lack of systematic and proactive operations can be seen as a weakness in the overall safety management of the company.

The ESSQ framework indicate that *quality management* is the case company’s greatest strength, and the company is located at the Toddlergrade model levels ‘*walk*’ and ‘*crawl*’. The case company’s management has goal- and customer-oriented approach to quality issues, but the concept of quality concept is

still not fully understood. The quality development of the case company focuses on Lean-thinking, Six Sigma and promotion of the process approach.

The examination of the subject companies selected for benchmarking through the ESSQ framework revealed that the framework as such could not be found in any company; instead, operations had been divided under different organisational branches. The assessment of ESSQ Management in the case company was carried out as a consensus of ESSQ viewpoints and on the basis of the three previous studies carried out in the case company. The assessed ESSQ maturity levels of the benchmarked companies are only indicative in nature, because the framework did not exist as such in any of the companies. Therefore, the emphasis of the interviews was shifted to benchmarking those sectors in which the said companies could be considered strong.

Table 13 describes the ESSQ Management maturity levels of the companies benchmarked according to the Toddlergrade model. In addition to the maturity levels, the strong ESSQ sectors of each company were assessed, namely, environmental and safety management in company A; safety management in company B; and quality management in companies C and D. Due to the lack of sufficient data, the management levels of company E were not assessed.

Table 13. The maturity levels of ESSQ Management in the case and BM companies (Tervonen et al. 2009, published by permission of Inderscience Enterprises Ltd).

Maturity model area	Leadership	Steering system	Follow-up systems	Innovativeness
Case company (ESSQ)	Roll over	Crawl	Crawl	Roll over
Company A (ESSQ)	Roll over	Crawl	Crawl	Roll over
Company B (ESSQ)	Walk	Crawl	Crawl	Walk
Company C (ESSQ)	Crawl	Crawl	Crawl	Crawl
Company D (ESSQ)	Roll over	Crawl	Crawl	Roll over
Case company (E)	Crawl	Crawl	Crawl	Crawl
Case company (SS)	Roll over	Roll over	Roll over	Roll over
Case Company (Q)	Walk	Crawl	Crawl	Walk
Company A (E)	Walk	Crawl	Crawl	Crawl
Company A (Q)	Walk	Crawl	Walk	Crawl
Company B (SS)	Run	Walk	Walk	Walk
Company C (Q)	Walk	Walk	Walk	Walk
Company D (Q)	Walk	Crawl	Walk	Walk
Scale	Run	Walk	Crawl	Roll over

ESSQ management *in the case company* in terms of ‘leadership and innovativeness’ is at the lowest level of the Toddlergrade maturity model, ‘roll-over’, whereas ‘steering and follow-up systems’ are one step higher at the ‘crawling’ level. One of the most important reasons for low maturity levels is that the concept of ESSQ is not considered in a holistic, all-inclusive manner but rather as separate sections. *Companies A and D* were assessed to be nearly *at the same level* with the case company. All three companies shared several similar operating methods and procedures, and none of them considered ESSQ management in a holistic manner. Another common characteristic for the three companies was also that they all considered safety as mere occupational safety. *Company D* was strong in ‘steering and follow-up systems’, in particular in the field of quality where a significant number of self-assessments were carried out.

Company B was assessed to be more advanced than the case company in the ESSQ framework even though company C was also not aware of ESSQ management as a whole. The company reached the ‘walk’ level in ‘Leadership and innovativeness’. The company had also won the Finnish quality award, and quality was deeply integrated in all its operations over the years. In addition, the safety organisation of company B had been created using a technology platform in which leadership and innovativeness are clear assets.

Company C was evaluated to be *on the same level with the case company* in the development of its ESSQ management and ‘steering and follow-up systems’ in particular. However, it was one maturity level higher, and reached the ‘crawl’ level in leadership and innovativeness. The position of company C at the leadership crawl level was supported by, among others, important investments made in the professional skills of project managers.

ESSQ management was promoted in the case company in order to reach operational and business excellence by utilising this benchmarking study, former analysis and theory. The models are also the practical findings and implications of the results of this study. Several development areas were identified in the case company, in particular through the studies in environmental management, safety and security management and quality management. Moreover, suggestions for development were obtained in benchmarking and later during the analysis of the results. It was discovered that the framework of the whole ESSQ management such could not be found in any benchmarking company and therefore operational and business excellence issues are targeted separately from the ESSQ management sectors.

No operational and business excellence models aimed at the development of environmental management were found, but the methods for quality management found do include environmental aspects. The all-inclusive approach to understanding and recognising the different environmental impacts of adopted economic solutions and decisions is suggested. By using scenarios, the approach will demonstrate and quantify the environmental impacts of such changes, which will contribute to establishing a better basis for manufacturer's judgements and responses. (see e.g. Elhag *et al.* 2008) A number of studies have particularly stated that it would be favourable for companies to integrate sustainability values into their core business values and strategies through integrated management systems because this is the optimal way to achieve sustainability in operations. (see e.g. Johnson & Walck 2004) Recent studies clearly show that a number of companies are now using environmental issues to strengthen their market position and access new markets (see e.g. Halkos & Evangelinos 2002, Van Berkel 2007)

One way to promote *operational and business excellence in safety management* would be to transform the case company's safety organisation to match the technology platform. The technology platform combines all sectors under one 'umbrella', which ensures that same services can be offered throughout the case company and overlapping operations can be avoided. Safety management and the creating a management system combine the various sectors of safety into one, and thus work as a coordinator between individual sectors. (see e.g. Choudry *et. al* 2007) It was noted that the corporate management plays a key role in the implementation of safety culture and management (see e.g. Flin 2003, Guldenmund 2000) Efficient and successful safety management depends heavily on the attitudes and the commitment of the organisation to safety issues (Bailey 1997, Clarke 1999, Kirwan 1998, O'Toole 2002).

It might also be beneficial to implement the "Security Champion" system in the case company in order to enhance the safety culture. The same model could be applied to the entire ESSQ management, at least at the initial stage when establishing operations. The successful development of a safety culture is one of the most important factors in the pursuit of successful safety management. Choudry *et al.* (2007) demonstrate that the creation of a positive safety culture can be an effective tool for enhancing corporate safety. Employees working in a positive safety culture feel responsible for their own safety, in addition to which they have a stronger sense of responsible for their peers' safety. The organisational culture thus encourages them to act in a responsible manner. If a company has a positive safety culture, the organisation's formal management

systems and the leader's informal management practices facilitate caring by encouraging, recognizing and reinforcing safe behaviour.

The results of this benchmarking study indicate that in order to promote *operational and business excellence in quality management* striving for better quality operations – towards quality culture – every member of the organisation must participate in and be committed to the related development measures. Da Silva *et al.* (2005) state that in order to remain successful, companies must develop their ability to face changes and provide their employees with an opportunity to present ideas and take risks. Internal quality award competitions and self-assessments encourage the said organisations to develop their operations. According to Da Silva *et al.* (2005), world-class companies exploit self-assessments in order to ensure continuous improvement, process control and monitoring that excel those of other companies.

In addition customer-oriented operations and increasing the customers' participation, the following factor were also found important: better recognition of customers and their needs, creating ideas and concepts with customers, include the customer in the verification and validation of the product and take advantage of all feedback from customers. Santos-Vijande's and Alvarez-Gonzalez's (2007) study indicates that TQM strongly influences a company's innovative culture and higher administrative innovation levels, which results in a greater degree of incorporated novelty, whereas the mediating role of innovativeness is required for TQM to achieve this impact on technical innovation.

3.5 The integration of ESSQ management and quality award models in leading international steel companies

The models of excellent business management, such as EFQM models, can also be used as tools for the integration and development of management systems. Their advantages include the embedded links between actions and results. The result-generating sections that, from the viewpoint of an organisation, control all operations can be integrated in the integrated management system. Such sections facilitate the integration of separate management systems into one entity. (Karapetrovic & Jonker 2003)

According to Wilkinson and Dale (1999), the benefits of the EFQM model in the implementation of an integrated management system are that they ensure development and continuous improvement. Integration can be based either on standards or the foundation of an all-inclusive quality management system, which

can be obtained through the quality award model. *Standards and their efficient use create a basis for quality assurance and quality control, for example, whereas EFQM and other quality award models add the viewpoint of optimisation and business.*

According to Bou-Llusar *et al.* (2008), the impacts of a number of quality awards and the EFQM model in particular on the performance of an organisation and the correlation between them and TQM core values. An extensive literature survey showed a clear connection between the EFQM assessment areas and TQM core values. Although categorised in a slightly different way, the same themes with slightly similar contents keep repeating. Juran (1999) notes that the most important advantage of quality award models is the increased communication between quality specialists and corporate management. This means, in practice, that benchmarking results of are communicated to the corporate management, which makes them aware of the company's situation and how other companies achieve their results.

The most important advantage of integration is the significant decrease in the number of overlapping systems. The decreased and optimised documentation, registration, bureaucracy and paperwork will save time and resources, in addition to which both internal and external audits will become simpler. Also, goals and responsibilities for different integrated areas are defined in one location on the basis of one management system. (Jørgensen *et al.* 2006, Zeng *et al.* 2007) According to Zutshi and Sohal (2005), the benefits include saving costs as the number of overlapping operations decrease, more efficient allocation of resources at the level of the organisation, improved communication of information and harmonised training of the personnel. In addition, the company's understanding of the requirements of its interest groups increases, as does the clients' trust in the organisation. This will result into enhanced corporate image.

A challenge in combining systems of different levels is the creation of an order of priority for the systems. Organisations may have long traditions in applying a quality management system, which is often the most advanced. When it is combined with more recent and less mature systems, the latter may end up being considered less important. However, if quality is at a high level at the time of integration, the development of other systems may consume considerable amount of time and resources, and therefore lead to decreased interest in the development of quality, which will eventually lead to its decline. (Zutshi & Sohal 2005)

It must also be noted that many have expressed reservations towards excellent management models, such as the EFQM model. Williams *et al.* (2006b) note that the implementation of the model did not always decrease the number of customer claims or improve the quality of the products. Sometimes even quality award winners are unable to remedy problems occurring in their operations. Self-assessment has become a liability and mere repeating of assessments will not bring any added value. Corporate management does not always use the model for improving the company's performance; instead, it is used for assessing units and their leaders.

Attitudes, both those of the corporate management and employees, also make development of an integrated management system challenging. Everyone must participate in integration work, in addition to which changes in routines and traditional operating methods must be successfully controlled. (Jørgensen *et al.* 2006) Sufficient resources must be allocated to the development and maintenance of the system in order to ensure successful full-scale integration. It may also pose difficulties for departments of an organisation to move from competition between departments to co-operation in order to support the common system. (Zutshi & Sohal 2005)

However, relations with interest groups will gradually improve, as do the employees' motivation and commitment to the company. The specialist panel did not agree on all aspects of the results but a clear majority stated that the implementation of the EFQM model is beneficial for a company. According to Conti (1997), a major benefit of quality award models is that self-assessment extends to cover a wide range of companies; they are not intended for only developing leading companies or quality award winners.

An organisation's ability to learn and evolve is paramount in the modern, constantly changing business environment. The advantages of quality award models in the management of intangible assets are mainly based on the strategic planning and forecasting included in the models. Furthermore, the exploitation of information and fact-based management contained in the EFQM model will promote innovation and expertise. Therefore the organisation learns and processes evolve. The areas of EFQM affecting employees will also affect on ensuring the development of intangible assets, such as knowledge and skill resources related to resource management. (Ehrlich 2006) Consequently, Martín-Castilla and Rodríguez-Ruiz (2008) consider that the EFQM model can also be used as a model for intangible asset management.

The responses of the benchmarked companies were processed anonymously, and the companies were given a letter code (A–G) for identification regarding maturity levels of ESSQ management in the international steel BM companies. The organisations who replied were located around the world. Four of the responses included all three viewpoints, two replies missed one and one reply only discussed one sector. The replies indicated that, in general, steel companies do not really apply integrated management systems to support their operations. Four out of seven organisations (Companies B, C, F and G) stated that their management systems were separate, at least from the viewpoint of ESSQ management. However, some of these companies had integrated some sectors e.g. environmental and safety management systems, at least to some extent.

Although *four of the companies* replied that their operations *were divided* in separate departments and they *considered their management system unintegrated*, they assessed themselves, on average, as *having the highest maturity levels also in terms of the total maturity of the ESSQ management system*. Company C also received the highest maturity rankings in analysis based on the replies. Although actual operations were located in separate departments, company C's practices nevertheless took the ESSQ viewpoint into account. *The development of operations was, however, integrated*. The replies do not indicate how close co-operation takes place between different departments. Possible close co-operation may leave room for the invisible creation of the ESSQ culture even though it was not supported by the organisational structure.

The remaining *three companies considered that their systems were integrated* but one of these companies, Company D, did not reply to the questions concerning the environment. This contradicts their statement of having an integrated management system. *The replies of other companies also indicated the lack of integration*. For example, there were different practices in different ESSQ sectors; responsibilities and roles were divided between different departments; and both development and process management were separate. Most companies seemed to be willing enough to have an integrated ESSQ system but the implementation had not yet been fully accomplished. According Jørgensen *et al.* (2006) and Zeng *et al.* (2007), change must take place at all levels of an organisation. Integration cannot remain a mere nominal change in organisation and integration of operations.

None of the companies stated that they use quality award models or at least they had not participated in a quality award competition. Some companies stated they had won smaller awards concerning different fields of ESSQ, mainly related

to the environment, occupational health and safety. Excellence-based awards rating the operations of the entire organisation, such as the European Quality Award or Malcolm Baldrige National Quality Award were not mentioned, nor was participation in any of them. It must be noted, though, that companies can base their operating systems on quality award models that have been tailored to meet the company's individual needs, rather than participating in arduous public competitions. Nevertheless, companies that replied to the questionnaire do not take systematically advantage of the quality award model. Earlier studies show that such awards are also useful for companies (see e.g. Conti 1997, Saizarbitoria 2006, Bou-Llusar *et al.* 2008).

Figure 17 shows a diagram of the average values calculated from the maturity levels both in different ESSQ sectors and the integrated ESSQ entity described in the previous chapters. The maturity levels are compared with that of the case company. The average values of the companies' self-assessments are marked in orange, evaluations made on the basis of their replies in blue and the values of the case company in red. The diagram axes refer to the different sectors of the Toddlergrade maturity model: 'leadership, business process management, business tracking system and innovativeness'. The maturity of the Toddlergrade model sectors increases when moving away from the centre. The innermost grey diamond indicates the 'roll over' level and the outermost refers to the 'run' level. The area formed by assessments thus indicates the total maturity of an organisation: the greater the area covered the closer the company is to the 'run' level.

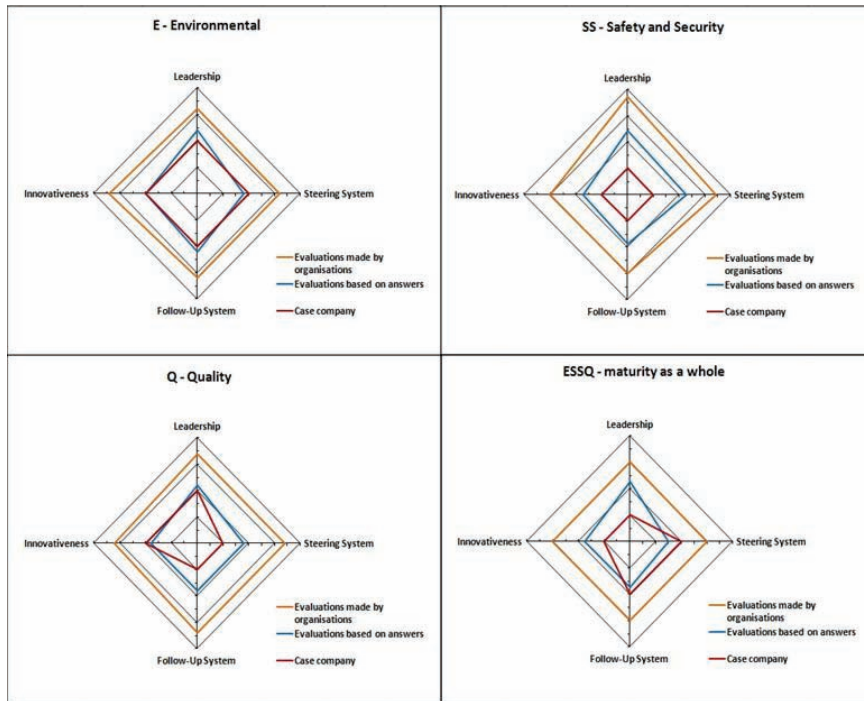


Fig. 17. The maturity levels of ESSQ management in the case and BM companies (Tervonen et al. 2010, published by permission of Inderscience Enterprises Ltd).

The diagrams clearly show that *the benchmarking companies* have, on average, assessed (orange line) their maturity levels to be *significantly higher* than those of *the case company*. Their evaluations are from one to two maturity levels higher in every ESSQ sector. The companies have, on average, assessed their maturity levels in all sectors close to the ‘walk’ level and in some sectors, such as safety and security ‘leadership and management systems’, even higher, close to the exemplary ‘world-class’ level.

The difference is clearly smaller when the maturity evaluations made on the basis of the replies (blue line) are compared with the case company’s values. No significant difference can be found in the maturity of environmental management; only the maturity of safety management is clearly lower, by about one maturity level. The case company’s total maturity levels for quality and ESSQ management vary, which is indicated in the figure with an inclined diagram. The value has become level in average calculations including several companies. The quality ‘process management and tracking systems’ are one maturity level lower than the levels indicated in the analysis of the companies’ responses. The total

maturity of the case company in 'process management and tracking systems' is slightly higher, but approximately one maturity level lower in other evaluated fields.

Self-assessments made by the companies were systematically approximately one maturity level higher than the level assessed only on the basis of their replies to the questionnaire. The evaluations of 'leadership' in occupational health and safety, in particular, show that five respondents out of seven grade themselves on the 'run' level, which is defined as a 'leading global forerunner' that sets an example to other organisations. The respondents either are the leading companies in the field or they have given themselves too high a grade, id est, they lack objectivity in their self-assessment, which is often the case in individual assessments.

ESSQ management was promoted in the case company in order to reach operational and business excellence by utilising this benchmarking study, former analysis and theory. These models are also the practical findings and implications of the results of this study. The international steel industry does not currently utilise integrated management systems or ESSQ-based integrated management systems, although the companies find such systems useful. In addition, international steel companies do not take advantage of quality award models in their operations, or at least they have not participated in a quality award competition.

However, integration is, in general, considered as a positive and beneficial matter. The elimination of overlapping operations, joint development of different sectors and better use of resources will save costs and, at the best, it can improve the company's operating culture. The progress of ESSQ management towards operational and business excellence requires that *integrated management systems must be tailored* to suit the organisation and not vice versa. The challenge is thus to get departments, which have previously been in charge of their own sectors, to work in genuine co-operation for the common goal. (see e.g. Wilkinson & Dale 2000, Jørgensen *et al.* 2006)

The use of quality award models can sometimes be problematic. Similar to standards, they are often considered too rigid and inflexible, in addition to which they have been criticised for focussing too much on short-term results and rankings instead of true development work. However, the motivation and commitment of the users determine the success of quality award models in a company. The progress of ESSQ management towards operational and business excellence requires that the best results can be obtained by *tailoring the quality*

award model to meet the needs of the organisation and not vice versa. Therefore, organisational culture and background play a clear role in the understanding and implementation of the EFQM model, which poses additional challenges in the work aimed at creating a system based on the models (see e.g. McCarthy & Greatbanks 2006). This way, the special characteristics of the organisation are fully taken into account. If used correctly, operations and self-assessment based on quality award models will create results (see. e.g. Hendricks & Singhal 1997 and 2001, Eriksson & Hansson 2003, Eriksson & Garvare 2005).

3.6 Research contribution synthesis

Research contribution synthesis is based on the consensus between the empirical results of this study and its theoretical framework. *Figure 18 shows research contribution synthesis of the individual articles and research questions.* The message of this study to other organisations is that the ultimate objective and the real contribution of integrated ESSQ management and the utilization of maturity models to business is that they provide *a framework, which helps companies to better understand and achieve these goals as a part of their overall operational and business management.* Every company should develop and customise a management model that is applied to its own specific needs (see e.g. Wilkinson & Dale 1999, Karapetrovic & Jonker 2003, Jørgensen *et al.* 2006).

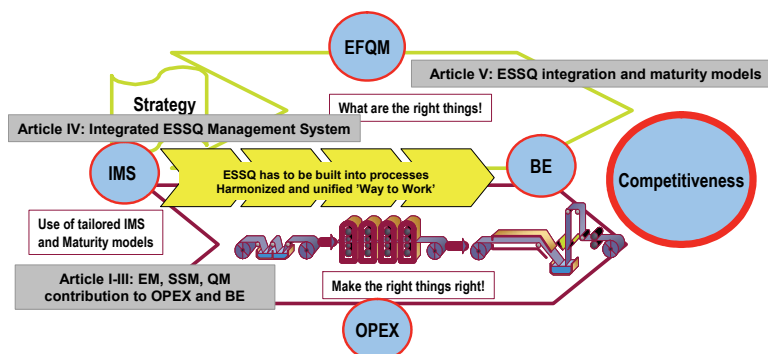


Fig. 18. Integrated ESSQ management as a part of excellent operational and business management.

The operating model based on the integrated ESSQ management systems and maturity models emphasise the importance of a *process-oriented approach*. The operations of a company can be analysed and developed more efficiently as

internal process chains than if they are considered as functional areas of responsibilities and organisational structures. The business processes of companies and their support systems should be increasingly harmonised in order to improve response time and efficiency. (see e.g. Hannus 1993, Laamanen 2001, Leclin 2006, Virtanen & Wennberg 2007) An inflexible and highly structured company will inevitably lose the race of markets to a flexible, company that can swiftly react to changes in the business environment. Successful organisations are characterised by their ability to recognise opportunities and risks before their competitors do. Continuous learning and development must be integrated in daily operations and management. Then, little by little, it will also become a part of the company's critical intellectual capital.

The management system may be of the umbrella type: *'all that can be integrated will be integrated'*. Operating models and procedures which are as highly integrated as possible support the company's: Management across organisational and site boundaries; The formation of a unified company culture; Unified actions with regard to customers and stakeholders; Rationalisation (personnel, tools, information systems, etc,..); Competence management; Ability to utilise internal 'Best practices'; and the development of rapid and fault-free processes. It is a question of *'harmonised and unified Way to Work'* and *the quality of management*. A significant result of the requirement of continuous improvement embedded into the company's management system is the concrete development programmes for the overall improvement of operations. (see e.g. Wilkinson & Dale 2001, Zeng *et al.* 2007)

The integration of ESSQ issues highlights the importance of a single, uniform management system. It is also a question of rationalisation and the sensible use of resources. The integration of ESSQ management systems makes the management of the operations easier, increases internal cooperation, and saves on resources, time and costs. *'Operational Excellence'* – *'Make the right things right'* means that *'there is no thing small enough not to do it right!* It means that *continuous improvements of processes and the way of work* are adjusted. It means leadership, teamwork and problem solving that result in continuous improvement throughout the organisation by focusing on the needs of the customer, empowering employees, and optimising existing activities in the process. Environment, safety and quality improvements for employees and customers all lead towards becoming a better, more efficient company. (see e.g. Wilkinson & Dale 2001, Zeng *et al.* 2007)

Without ESSQ integration, the possibilities for rationalisation are lost and the understanding of overall business operations is reduced in all organisations. Consequently, operations at the organisational interfaces may become difficult, processes crossing organisational boundaries decline or do not develop – grey areas are created. Organisations begin to form parallel or competitive processes and overall internal development becomes blurred. When seen from the point of view of the operator – why are there a number of parallel operating models for doing the same work? The maintenance of separate systems requires a lot more work.

ESSQ-issues, similar to other matters connected with business operations, are integrated in the company's operations from the corporate strategy onwards, which means that *the integration of ESSQ issues is natural process*, but is as such not of absolute value (see e.g. Zeng *et al.* 2007). The use of *the EFQM model* as described in conjunction with maturity models as a tool for developing a company's operations and the *Toddlergrade maturity model* developed in the case company create a good framework for the recognition and development of competitiveness and excellence – *Business Excellence – 'What are the right things?'*. The models are based on characteristics of excellence and they are a good tool when improving competitiveness. However, it does not identify the procedures that should be applied in great detail. (see e.g. Sandbrook 2001, EFQM 2007).

The EFQM model has, however, not become a functional management tool for the improvement of competitiveness, because it has not been integrated in the annual *strategic planning process and practical business operations*. The EFQM model should be integrated in the strategic corporate planning process as an integral part and in process-oriented business operations and monitoring systems by taking advantage of the existing operating models of the integrated ESSQ management system. The link between strategic planning and operative actions has too often remained insufficiently weak or it has not been created at all. In addition, process-oriented practical operations have not been efficient enough.

In successful organisations, a solid connection between the EFQM model and strategic planning process can be found. In addition, their management processes are made more transparent in order to create a clear connection between the company's vision and its results. A process approach is also recognised as an important tool. Thanks to the practical application of the model, the planning of corporate strategy, continuous improvement, monitoring and learning will become more efficient and systematic. The excellent competitiveness of an organisation

requires continuous improvement, which means that the only permanent competitive advantage of any organisation is to develop and learn faster than its competitors (see e.g. Eriksson & Hansson 2003, Eriksson & Garvare 2005).

The framework for competitiveness and excellence created on the basis of the *integrated ESSQ management system, the EFQM model* and the *Toddlergrade model* is not a new, fashionable management trend aimed to find a quick fix for a specific problem. It is not a new, arduous management system that all operations must be made to match. The systems approach does create synergy advantages and it creates a good basis for continuous improvement. Then, the recognition and *development of critical success factors (BE) and management of operations (OPEX)* will become more straightforward and more efficient.

Table 14 summarises the research contributions of the individual articles and research questions. A historical overview on the development of environmental, safety and security, and quality management will help to better understand the logics, framework, benefits and challenges of an integrated ESSQ model. In addition, the examination of the EFQM both as a maturity level assessment tool and as a part of the integrated ESSQ management system will shed light on the framework, benefits and challenges of the ESSQ management system.

Table 14. Summary of research contribution.

RQ #	Data	Method	Results
1	13 interviews in the case company (4 works)	Hermeneutic Multiple case study Qualitative interviews Case methods	General development path of environmental management Development steps of environmental management in the case company Future operating models for environmental management in the case company
2	12 interviews in the case company (4 works)	Hermeneutic Multiple case study Qualitative interviews Case methods	General development path of safety management Development steps of safety management in the case company Future operating models for safety management in the case company
3	10 interviews in the case company (4 works)	Hermeneutic Multiple case study Qualitative interviews Case methods	General development path of quality management Development steps of quality management in the case company Future operating models for quality management in the case company

RQ #	Data	Method	Results
4	4 interviews in 4 national BM companies 1 workshop in 2 national BM companies	Hermeneutic Multiple case study Qualitative interviews Case methods	The framework, benefits and challenges of Integrated ESSQ management Maturity level of ESSQ management in the case and Finnish BM companies ESSQ management promotion to operational and business excellence
5	7 questionnaire in 7 international steel BM companies	Hermeneutic Multiple case study Qualitative questionnaires Case methods	The benefits and challenges of ESSQ integration and utilization of EFQM model Maturity level of ESSQ management in the international steel BM companies ESSQ management promotion to operational and business excellence

4 Discussion

In this chapter 4, theoretical and empirical findings and implications of the contributions are discussed, the reliability and validity of the research results are considered and recommendations for further research are made. The research problem is studied through five articles published in international professional journals, and they cover the theoretical foundation for the research and empirical study in the case company and in the BM companies.

4.1 Theoretical findings and implications

This chapter 4.1 presents detailed theoretical findings and implications of the each research papers. As a summary of the theoretical findings and implications, this dissertation clarifies background of ESSQ management and provides new knowledge on how to utilise integrated ESSQ management and maturity models *EFQM and Toddlergrade* as a part of excellent operational and business management. Table 15 summarises the theoretical findings and implications of the five research articles after which the implications of the research articles are discussed.

Table 15. Summary of theoretical findings and implications.

Article	Theoretical findings	Theoretical implications
I	Traditional EM, Modern EM, EMS, Eco-competitiveness, current view of EM	Support existing knowledge regarding EM and general development paths of EM
II	Reason's model of human perspective, equipment and machines and organisational perspective, national legislation and regulations, SSM, safety culture, current view of SSM	Support existing knowledge regarding SSM and general development paths of SSM
III	I, QC, QA, TQM, quality management maturity models, systems approach, current view of QM	Support existing knowledge regarding QM and general development paths of QM

Article	Theoretical findings	Theoretical implications
IV	<p>Focussed use of relevant standards. Systematic and process-like approach</p> <p>The framework, benefits and challenges of integrated ESSQ management</p> <p>Harmonized and unified 'Way to Work' – OPEX and BE</p> <p>Interaction and co-operation with interest groups</p> <p>Organisational culture and learning organisation</p> <p>Recognition and introduction of best practices</p>	<p>Support existing knowledge regarding framework, benefits and challenges of integrated ESSQ management system</p> <p>Creates new knowledge on how to utilize maturity (Toddlergrade) models in integrated ESSQ management</p>
V	<p>Tailored use of the EFQM model</p> <p>Systematic and process-like approach</p> <p>The benefits and challenges of ESSQ integration and utilization of EFQM model</p> <p>Harmonized and unified 'Way to Work'- OPEX and BE</p> <p>Interaction and co-operation with interest groups</p> <p>Organisational culture and learning organisation</p> <p>Recognition and introduction of best practices</p>	<p>Support existing knowledge regarding benefits and challenges of ESSQ integration and utilization of EFQM model</p> <p>Creates new knowledge on how to utilize maturity (EFQM and Toddlergrade) models in integrated ESSQ management</p>

Article I-III supports the existing knowledge on environmental, safety and quality management as a part of business management and general development paths of environmental, safety and quality management. The novelty of articles I-III is that there is very little research on the evolution of environmental, safety and quality issues and the utilisation of environmental, safety and quality management systems in the steel industry. *Article IV* supports the existing knowledge regarding the framework, benefits and challenges of integrated ESSQ management system and provides new knowledge on how to utilise the Toddlergrade maturity model in integrated ESSQ management. *Article V* supports the existing knowledge regarding the benefits and challenges of ESSQ integration and utilization of the EFQM model and provides new knowledge on how to utilise the EFQM and Toddlergrade maturity models in integrated ESSQ management. The novelty in *articles IV-V* is that there is currently very little research carried out from the viewpoints of the different sectors of ESSQ management as one whole. Adding research in maturity models is also included in the study of integrated ESSQ systems and creates the kind of research that has not really been carried out before.

The different sectors of ESSQ management currently include a number of characteristics and operations of management that are similar from one sector to

another. The different interests of an organisation merge and the same resources are utilised in various parts of the organisation. The different sectors of ESSQ management have, however, developed at different speeds. The similarities between ESSQ management sectors are related to harmonised management models – from passivity to forced activity and proactive operations, from individuality to machines and organisational development, and from quality control to all-inclusive quality management. The similarities in different sectors of ESSQ management are related to the structures of the management system, goals, monitoring and the operation models and tools used.

Article I illustrates the general development of environmental management. The case company also follows the general development trend, and thus complements the existing literature (see e.g. Petulla, 1987, Tervonen 1999, Kallio, 2001, Kolk & Mauser 2002, Heiskanen 2004, Rice 2003, Johnson & Walck 2004, Zutshi & Sohal 2004).

Article II discusses the overall development of safety management and describes the different levels or extents of safety management, for example as defined by Reasons (1997): people, machine or equipment and organisation, and thus complements the existing literature (see e.g. Ruuhilehto & Vilppola 2000, Kerko 2001, Hämäläinen & Lanne 2001, Choudhry 2007). The development of safety management in the case company follows the descriptions and mapping found from the literature partly due to compulsory legislative regulations.

Article III examines the general development of quality management and thus complements the existing literature (see e.g. Bounds 1994, Dale 1999, Hannukainen *et al.* 2006). These development steps can also be clearly seen in the case company's quality management practices.

Article IV shows that a successful integrated ESSQ management system requires that all elements of the system have been integrated as natural parts in the operations and culture of the organisation. In this case, one can talk about a systematic and process-like approach and reasonable behavioural models adapted to the working environment. All these aspects create the basis for a sustainable organisational culture. The operating models and tools used must always be tailored to match the organisation and culture in which they are applied. A maturity model – Toddlergrade – was also developed in this study for the improvement of ESSQ management. The application of the operating models, tools and best practices that are common to all ESSQ management sectors and uniform organisational culture creates operational and business excellence. (see

e.g. Wilkinson & Dale 2001, McCaffery & Coleman 2007, Zeng *et al.* 2007, Lee *et al.* 2008).

Article V shows that companies utilise a number of different maturity models suitable for different sectors; there is no uniform model or a model that could be used for examining the entire entity. (see e.g. Ridley *et al.* 2004, Beecham *et al.* 2005, Von Solms 2005, Gottschalk & Solli-Saether 2006, Jokela *et al.* 2006, McCaffery & Coleman 2007, Frisco & Stalebrink 2008) The most popular model, which is also suitable for different sectors, is the EFQM model, which examines the operations and procedures of organisations from the viewpoint of business. The operating models and tools used must always be tailored to match the organisation and culture in which they are applied, similar to the EFQM model. In this case, one can talk about a systematic and process-like approach and reasonable behavioural models adapted to the working environment. All these aspects create the basis for a sustainable organisational culture. The recognition and introduction of best practices is paramount.

4.2 Managerial findings and implications

This chapter 4.2 presents detailed managerial findings and implications of each research article. As a summary of the managerial findings and implications, this dissertation provides new knowledge on how to utilise integrated ESSQ management and maturity models EFQM and Toddlergrade as integral parts of excellent operational and business management concerning the case company, in particular, but also other organisations. Table 16 summarises the managerial findings and implications of five research articles, after which implications of the research articles are discussed.

Table 16. Summary of managerial findings and implications.

Article	Managerial findings	Managerial implications
I	<p>Development path of EM: 1960' passive trend, 1970's traditional EM, 1980's modern EM, 1990's forerunner, 2000's strategic opportunities</p> <p>State of EM maturity level: "Proficient"</p> <p>Future operating model for EM: Eco-competitiveness</p>	<p>Learning by history – appreciation of present state</p> <p>Use of tacit knowledge</p> <p>Use of tailored EM and maturity models</p> <p>Use of characteristic of EM excellence especially eco-competitiveness</p>
II	<p>Development path of SSM: 1960–1980's Reason's (1997) safety management model from human perspective, 1990's Reason's (1997) model of the safety management of equipment, 2000's Reason's (1997) model of the organisational perspective of safety management</p> <p>State of SSM maturity level: Maturity level varies by corporate safety sectors from "Optimizing to below the level"</p> <p>Future operating model for SSM: Corporate safety management system and safety culture</p>	<p>Learning by history – appreciation of present state</p> <p>Use of tacit knowledge</p> <p>Use of tailored SSM and maturity models</p> <p>Use of characteristic of SSM</p> <p>Excellence especially safety culture</p>
III	<p>Development path of QM: 1960–70's I, beginning 1980's OC, mid-1980's OA, 1990' TQM, 2000's process thinking, Lean, Six Sigma, excellence criteria, integrated ESSQ management</p> <p>State of QM maturity level: "Improver"</p> <p>Future operating model for QM: TQM weighted 'Investment' model – quality culture towards higher maturity level</p>	<p>Learning by history – appreciation of present state</p> <p>Use of tacit knowledge</p> <p>Use of tailored QM and maturity models</p> <p>Use of characteristic of QM excellence especially quality culture</p>

Article	Managerial findings	Managerial implications
IV	<p>Tailored use of relevant standards</p> <p>The framework, benefits and challenges of integrated ESSQ management</p> <p>Decentralized ESSQ management in the Finnish BM companies</p> <p>State of ESSQ management maturity level in the case company: '<i>Roll over and Crawl</i>'</p> <p>In the case company maturity level of ESSQ generally on the same level than in the Finnish BM companies except Maturity level of SS clearly lower</p> <p>Business excellence promotion for ESSQ management: safety and quality culture</p>	<p>Learning by benchmarking – OPEX and BE</p> <p>Use of tailored IMS and Toddlergrade maturity model</p> <p>Process based Integrated ESSQ management = KISS = Keep It Short and Simple</p> <p>Harmonized and unified 'Way to Work' BE & OPEX – What are the right things and make the right things right!</p> <p>Use of characteristic of ESSQ excellence especially organisational culture</p>
V	<p>Tailored use of the EFQM model</p> <p>The benefits and challenges of ESSQ integration and utilization of EFQM model</p> <p>Decentralized ESSQ management in the international steel BM companies</p> <p>Maturity levels in the BM companies one to two maturity levels higher in every ESSQ sector, but no significant difference when assessment done by basis of the replies only the maturity of SSM is clearly lower in the case company</p> <p>Quality Award models not operationalised in the international steel BM companies</p> <p>Business excellence promotion for ESSQ management: tailoring integrated ESSQ management and EFQM maturity model</p>	<p>Learning by benchmarking – OPEX and BE</p> <p>Use of tailored IMS and EFQM/Toddlergrade</p> <p>Process based integrated ESSQ management = KISS = Keep It Short and Simple</p> <p>Harmonized and unified 'Way to Work' BE & OPEX – What are the right things and make the right things right!</p> <p>Use of characteristic of ESSQ excellence especially tailoring IMS and EFQM</p>

In general, it can be noted that the essential factor in using the integrated ESSQ management system, EFQM model and the Toddlergrade maturity model is not the use of the tools as such but to be able to assume the characteristics of business excellence (BE) as integral parts of corporate strategy and all operations (OPEX). The correct content of business operations and the right direction are paramount, and the corporate strategy, goals and excellent performance should reflect these aspects. The systems approach places particular emphasis on a process approach. Business processes and their support systems should be increasingly harmonised in order to improve response time and efficiency. Financial result is increasingly generated using the expertise of employees. Skills and knowledge management

has become an increasingly important competitive factor in companies in the last couple of years. Innovation and learning also play a key role in the integrated ESSQ management system and the exploitation of the EFQM model.

Articles I-III the most important managerial implications of the articles are: learning from history, use of tacit knowledge, the use of tailored ESSQ management and maturity models and the use of the characteristics of ESSQ management excellence in order to develop organisational culture, in particular. According to Silen's (1998) model, the organisation must find ways to develop its quality culture and therefore improve its performance. Choudhry *et al.* (2007), for example, demonstrate that developing a positive safety culture can be an effective tool for improving safety (see e.g. Afrazeh & Bartsch 2007). Learning from history creates a basis for understanding why certain things are today done the way they are. Learning from history also helps to avoid earlier mistakes. It is important to examine and analyse the current situation in order to avoid repeating earlier mistakes in the future and remedy errors once one finds out how to target improvement measures. Historical information also provides tacit knowledge that might otherwise be left unnoticed. The assessment of the current status of different ESSQ management sectors and the maturity level of the organisation help to better target development measures. Proposed future operating models serve as support data when assessing the future of integrated ESSQ management.

Article I shows that the development of environmental management in the case company follows the general development trends. The phase of modern environmental management is still the main trend and it identifies the strategic potential of environmental factors. The most important future operating model of environmental management in the case company is likely to be eco-competitiveness. Singh *et al.* (2008) present the current environmental strategies in the steel industry as fairly dynamic and depending primarily on the interests of various stakeholders. This also supports the assumptions of the stakeholder theory about the positive impact of a good environmental actions on community (Waddock & Graves 1997). Gupta and Goldar (2005) found similar effects and concluded that the markets generally penalise environmentally unfriendly behaviour.

Article II discusses the overall development of safety management and describes the different levels or extents of safety management, for example as defined by Reasons (1997): people, machine or equipment and organisation. The organisational model has common points with TQM and it emphasises anticipation and continuous improvement of the system (Herrero *et al.* 2002). The

development of safety management in the case company follows the descriptions and mapping found from the literature partly due to compulsory legislative regulations. The most important areas in future operating models in safety management will be the building of a corporate safety management system and the development of safety culture. Azadeh (2000), for example, states that management is the key in assuring that risk and reliability, quality engineering, human engineering and teamwork programmes function properly.

Article III discusses the development of quality management as a four-stage process as it is often described in the literature: I, QC, QA and TQM. This four-stage phase is clearly identifiable in the case company's quality management development. In addition, at the present it can be seen quality system and process-based thinking in terms of more complex approaches to quality development, such as Lean thinking, Six Sigma and the utilisation of excellence criteria. The TQM-weighted future quality management operating model describes a situation that could be reached as an outcome by strengthening the strong areas and developing the weak ones indicated in this study. In this model, certain tacit, behavioural and intangible features such as an open culture, employee empowerment and executive commitment, can produce an advantage. (see e.g. Dale & Mcquater 1998, Cauchick 2005, Longbottom *et al.* 2006)

Articles IV-V the most important managerial implications of the articles are: the use of benchmarking in learning processes, the use of tailored IMS and maturity models (EFQM and Toddlergrade) and how to keep them short and simple taking the process-based approach into account, the use of characteristics of ESSQ excellence in particular in organisational culture and the tailoring of IMS and maturity models. It is of paramount importance that the characteristics of business excellence (BE) are recognised and integrated as central components of the strategy and all operations of a company (OPEX).

The integration of operating systems is, almost without exception, challenging because the best integration method depends heavily on the existing characteristics of the organisation and there is no common universally applicable model. The success of integration depends on the content of the existing systems to be integrated, field of business of the organisation, organisational culture and a number of other factors. (see e.g. Wilkinson & Dale 1999, Karapetrovic & Jonker 2003) The process approach means that the organisation moves from a traditional profit unit organisation towards a matrix organisation and further to a process organisation. (see e.g. Hamel & Prahalad 1994, Hannus 1994, Virtanen & Wennberg 2007) One of the requirements of a successful integrated management

system is that the various elements of the system have been connected with the natural operations and culture of the organisation. (Voutilainen *et al.* 2001) According to Wilkinson & Dale (1999), the advantages of the EFQM model when implementing an integrated management system is that it secures development and continuous improvement. Integration can be based either on standards or the establishment of all-inclusive quality management, which can be obtained through the quality award model.

Article IV shows that of the requirements of a successful integrated management system is that the various elements of the system have been connected with the natural operations and culture of the organisation (see e.g. Lee *et al.* 2008). It also indicates that the systems approach is based on the process approach of which ESSQ plays a role in certain viewpoints. The main advantages of integration are operational and business excellence (see e.g. Jørgensen *et al.* 2006, Zeng *et al.* 2007).

An integrated ESSQ management framework, as such, does not exist in the case company or any other benchmarking companies; instead, operations have been decentralised under different organisations. The companies, however, do find such systems useful. Operational and business excellence management methods and the procedures of ESSQ management will form a foundation for future operating models that can be applied in the case company, as well as the improved level of integration. This means that the organisational culture must support integration (see e.g. Voutilainen *et al.* 2001) and integrated management systems and the utilisation of maturity models must be tailored to suit the organisation and not vice versa. The Toddlergrade maturity model developed by the case company offers a simple solution: it is easy to use, it allows rapid assessment of a company's maturity level and it can be applied to different levels of organisations as well as organisations of different sizes and operating in different fields of industry.

Article V shows that companies utilise several different maturity models that can be applied to different sectors; there is no uniform model or a model that could be used for examining the entire entity. (see e.g. Ridley *et al.* 2004, Beecham *et al.* 2005, Von Solms 2005, Gottschalk & Solli-Saether 2006, Jokela *et al.* 2006, McCaffery & Coleman 2007, Frisco & Stalebrink 2008) The most popular model, which is also suitable for different sectors, is the EFQM model, which examines the operations and procedures of organisations from the viewpoint of business. However, the operating models and tools used, for example the EFQM model must always be tailored to meet the needs of the

organisation and culture in question. Steel companies did not indicate that they would really use quality award models or that they would have participated in quality award competitions but the companies, however, find such systems useful. The utilisation of the EFQM model, seen from the viewpoint of maturity models, creates a good framework for the recognition and development of competitiveness and excellence. (see e.g. Sandbrook 2001, EFQM 2007).

4.3 Validity and reliability

In this chapter 4.3, validity and reliability of the research results are discussed. In principle, this dissertation follows the qualitative approach. This dissertation is composed of five research papers, in which the qualitative approach is also applied. The critical evaluation of the study focuses on the assessment of its reliability and general applicability from the viewpoints of first and foremost the research questions and the answers discovered. In the critical evaluation, reliability is described as *validity and reliability*. Validity refers to examining whether the study meets the research goals set and whether the research carried out is relevant to the topic. The objective of reliability is to examine the repeatability of the study and whether the same result would be achieved if the study was repeated using the same research methods. (Metsämuuronen 2006, Creswell 2006, Bogdan & Biklen 2007, Edmonson & Irby 2008, Gray 2009)

The objective of the critical evaluation of the study is to assess the validity and relevance of answers received to research questions. Validity means that the theory, model or concept must accurately mirror reality (Järvinen & Järvinen 2000). Validity also refers to the ability of the metrics used in the study to measure the subject matters of the study. This is a question of the theoretical and operational definitions of the concepts used in the study as well as the assessment of correspondence between theoretical and operational definitions. (Olkkonen 1994) Yin (2003) defines the aforementioned concept of validity as structural validity. Structural validity can be enhanced using three methods: 1) by using several sources to obtain evidence for the study, 2) by creating a logical chain between separate pieces of evidence and 3) by allowing informants to check the draft report.

When assessing the *structural validity* of dissertation, it can be noted that the measures that, according to Yin (1993), can be taken to improve the structural validity of a study, have been completed. Numerous sources have been used for the creation of the theoretical framework and empirical data, in addition to which

different factors and results have been presented in a logical manner. All interviewees and benchmarking companies had the opportunity to check the research results. The factual information of this dissertation has been verified by the case company and representatives of the benchmarking companies that replied to the questionnaire prior to making research conclusions. The structural validity of the dissertation can therefore be considered good.

According to Yin (1993), the level of research can be assessed on the basis of its internal and external validity as well as reliability. Internal validity refers to the accuracy of causal relationships presented in the study and it answers the question of whether the conclusions made in the study are the correct ones. External validity refers to the general applicability of the results. It is often difficult to make generalisations on the basis of only one case; instead, several identical studies are needed, which is referred to as repetition. Reliability indicates how probable it is that the results obtained are accurate. It also describes the repeatability of the study, i.e., what is the likelihood of obtaining the same result if the study is repeated. Reliability is also used to describe variation in the random phenomena in the study. (Olkkonen 1994, Yin 2003, Edmonson & Irby 2008, Gray 2009)

The accuracy of causal relationships related to the *internal validity* of the dissertation has been enhanced by interviewing a number of persons working in the case company and making summaries of their replies. In addition, several companies were interviewed in the benchmarking process and summaries were made of their replies. The accuracy of replies, which deviated from the common trend, was assessed on the basis of the work history of the interviewee. Separate opinions have been presented in such a way that they can be clearly identified from the text. Internal validity has also been enhanced by linking theory, corpus and results with each other, which was also used as a foundation for the conclusions made in this dissertation.

The *external validity* of the dissertation is not, in practice, limited to the case and BM companies, because the issues described can be seen as generic, which allows them to be observed in a wider perspective. The ESSQ practices, maturity model and the use of system-based integration as a basis for operating systems, in particular, can be used in wider contexts. In this case, the ESSQ perspective serves as an example, whereas the framework is of a generic nature.

The validity of questionnaires and interviews is primarily affected by the relevance of the questions with respect to the research problem. Inappropriate questions compromise the quality of results and may lead to useless or inaccurate

replies. (Heikkilä 2005, Yin 2003) In this dissertation, the questions were mainly qualitative and they were based on the literature referred to in the theoretical framework of this study. The questionnaire was also approved by the case company representatives and e-mailed to informants prior to interviews, in order to get profound knowledge from the practices used in BM companies. In addition, the questions used in benchmarking were based on the analysis and results of the three articles on the case company's ESSQ management, and on the fourth article of ESSQ management in Finnish BM companies.

Errors attributed to the interviewer include unclear instructions for reply, unclear formulation or presentation of questions, the influence of the interviewer's own attitudes, social distance, errors in recording the replies, lapses of memory and errors in motivation. In addition, the time and place of the interview and the interviewee's state of mind may affect the answers. The interviewees may try to give answers that they feel are acceptable or expected of them. (Heikkilä 2005, Yin 1993) In order to overcome these challenges, the following measures were taken during the research process: clear instructions for answering the questions and unambiguous questions were formulated, interviews were tape-recorded and the place and time of the interview were mutually agreed.

The *reliability* of the dissertation was enhanced by ensuring the anonymity of respondents, by sending the questions to them in advance, tape-recording the interviews and preparing for the interviews. The informants in the case company and benchmarking companies were informed that the names of no companies would be published, which gave them the possibility to give more critical answers. The questions were sent to the informants prior to the interview so that they had the opportunity to familiarise themselves with them before the actual interview took place. Careful processing of the results and analyses from the tape decreased the possibility of misunderstandings and lapses of memory. The fact that the informants had the opportunity to familiarise themselves with the questions and partly even answer them prior to the actual interview increases the reliability by allowing the informants to consider their responses before answering. Tape-recording the interviews decreases the possibility of misunderstandings. The informants were also informed that their replies would be processed anonymously, which gave them the opportunity to be more critical in their answers.

The challenge of the written questionnaire was that replies were only transferred in writing, e.g. there was distance between the informant and the researcher. In this case, possible misunderstanding of the questions cannot necessarily be seen in the responses and the clarification of the questions and

answers is more difficult. However, the questionnaires of the dissertation was made as clear as possible and the questions were short and concise, which improves the reliability of the replies. An introductory section describing ESSQ management and thus defining the framework of the study was placed in the questionnaire.

The researcher's personality and knowledge always affect the interpretation of qualitative data. However, the objective was to reach as high a level of objectivity as possible and present all the most important findings. It is highly likely that the same issues would be brought up if the same people were to be interviewed again. It is likely that the study, if repeated, would give more specific, detailed and comprehensive replies to some issues but it is nevertheless very likely that the subject matter and the main findings of this study would remain unchanged.

4.4 Recommendations for further research

In this chapter 4.4, recommendations for further research are made. The areas of development identified in this study are all possible areas of further research and assessment. Several operating models aimed at developing operations that were identified in this study can also be applied in practice by tailoring the models to meet the needs of the case company. All operating models need to be tested for suitability prior to applying them to the operations of the entire case company. The implementation of future operating models is a long and complex process, which required commitment from the entire company, senior management included.

From the viewpoint of environmental management, a separate study could be made on the weak and strong signals of the EU environmental legislation and their impacts on the steel industry. From the viewpoint of safety and security management, safety culture could be examined in more detail because it plays a crucial role in the level of corporate safety. In this case, attention should be paid to making operating methods more systematic and anticipatory and in which areas this would be particularly important. Safety data system is a highly challenging object of further research. Data systems are often considered to have many weaknesses and inadequacies. Therefore, it might be fruitful to find out what would a good system be like and how the existing systems could be improved. The safety management perspective also provides an interesting theme for future research: profitability of corporate safety management. Attention should then be

paid to the order of priority and amount of investments needed in the development work in the light of the benefits gained. The equal development of all options may not be sensible or financially feasible.

From the viewpoint of quality management, a number of development points indicated in this study can already be applied by directing the organisational culture in the desired direction. Some areas can, of course, be developed and improved without any changes in the organisational culture. However, if the company considers it important to change its culture and thus positively affect a number of development areas, further research would be needed to comprehensively discuss the related matters. Changing the organisational culture is a long and complex process and it cannot be done in only one project. In order to succeed, commitment and example from the senior management are also needed. No results can be obtained without a clear will, vision and leadership.

Several themes and questions for further research were found in the field of integrated ESSQ management systems. Also, the advantage of maturity models, such as quality award models and the Toddlergrade maturity model developed in the case company, would open new opportunities for further research. Their detailed empirical study was, in this case, found to be impossible because companies operating in the steel industry did not really use quality award models or participate in quality award competitions. It would be interesting to find out whether this is a common trend in the steel industry or if there is a specific reason for not using quality award models. The use of quality award models was, in the theoretical part of this study, found to be beneficial to the company and it would therefore be useful to examine whether the steel industry is an exception to the rule, or if the industry has not yet discovered their use. There is very little research in the correlation between success in quality award competitions and the use of integrated management systems, which would also be a fruitful theme for further research.

5 Summary

This chapter 5 summarises the research. Companies must be more competitive than ever to be able to meet the future challenges of their business environment. Companies that can rapidly react to the increasing demands and expectations of markets have also good opportunities to gain competitive advantage, and therefore companies have started to develop their planning processes and management systems. Companies need a relevant, well-functioning management system regardless of their field of business, size, structure or status of business. A management system desired by all companies consists of flexible operating methods and low level of bureaucracy.

Management has been defined in several different ways. It can be described on the basis of its objective, nature and content. Management is a phenomenon related to organisations, and its objective is to ensure that the basic objectives of the organisation are achieved, ensure that operations are smooth and efficient, adapt the unit to the changes and demands of the business environment and ensure that the organisation serves those that it is supposed to serve. The definitions indicate that the objective of management is to obtain goal-oriented operations with the help of people and with people by utilising other resources. To summarise, management is the will and skill to make an organisation and its different units work for a common goal in compliance with a common strategy.

When examining management from the viewpoint of the systems approach, an all-inclusive management system of a company plays a central role. The management system also includes ESSQ issues and other critical success factors. Companies will need increasingly efficient and productive systems in order to maintain their competitiveness. Such systems should therefore continuously improve the company's operation and increase the satisfaction of its customers and other interest groups.

The research questions are intertwined: they are related to each other, even though their focus is different. Each of these areas is large and would be worth further study. The research questions 1–5 move from basic issues and decentralized elements towards an integrated approach to integrated ESSQ management systems. These perspectives were chosen to be able to increase understanding in the nature of the ESSQ management as a whole, and the integrated management system consisting of all of these elements. The research problem of this dissertation is stated as follows:

There is a lack of knowledge on effectively integrating a management system in the areas of Environment, Safety & Security and Quality into a company

As a general conclusion, it can be stated that the starting points of integrated management systems were requirement by the customers and the authorities on one hand and similarities between different areas of operation on the other hand. It is only sensible to join different areas of operations with similar aspects because the reasons for problems may be common to them all, in addition to which finding a narrow solution to one problem in one field may cause difficulties in other fields. The consideration of maturity models increases the business- and customer-oriented nature of operations. Integrated, all-inclusive management systems that take all essential critical success factors into consideration approach natural operations of an organisation. Joining different operational entities into one system facilitates the management of resources, increases internal co-operation and saves resources, time and costs.

As a rule of thumb, every company should develop a management model that has been tailored to meet the needs of the company in question. The starting point of all-inclusive management is that needs can only be fully addressed when all relevant variables in the organisational system are taken into consideration. Systematically integrated, well-functioning management systems that include all operating models in a comprehensive way are not yet common, but there is a clear trend towards systems integration.

In order to find a solution to the problem, this dissertation approached the matter from different perspectives with five research questions. Each question was discussed in an individual research article. Five research questions (1–5 RQ) were formed in order to make synthesis of the research findings. Table 17 summarises the research questions and their contributions:

Table 17. Research questions and contributions.

RQ #	Research question	Contributions
1	What are the general and case centred EM development paths and contribution to the case company OPEX and BE?	General EM development path and that of the case company Current status of environmental management and maturity level of the case company Exploitation of historical data and current status assessment date in the environmental management of the case company Future environmental management operating models in the case company Generic environmental management operating models OPEX and BE
2	What are the general and case-centred SSM development paths and contribution to the case company OPEX and BE?	General SSM development path and that of the case company Current status of safety and security management and maturity level of the case company Exploitation of historical data and current status assessment date in the safety and security management of the case company Future safety and security management operating models in the case company Generic safety and security management operating models OPEX and BE
3	What are the general and case centred QM development paths and contribution to the case company OPEX and BE?	General QM development path and that of the case company Current status of quality management and maturity level of the case company Exploitation of historical data and current status assessment date in the quality management of the case company Future quality management operating models in the case company Generic quality management operating models OPEX and BE

RQ #	Research question	Contributions
4	What are the framework, benefits and challenges of an integrated ESSQ management system versus BM companies?	<p>The framework, benefits and challenges of integrated ESSQ management</p> <p>The ESSQ management maturity level in the case company compared with the Finnish BM companies that are national leaders in ESSQ matters</p> <p>Exploitation of the OPEX and BE operating models obtained through benchmarking in the ESSQ management of the case company</p> <p>Generic ESSQ management operating models OPEX and BE</p> <p>Creating new knowledge on how to utilize maturity (Toddlergrade) models in integrated ESSQ</p>
5	What are the benefits and challenges of ESSQ integration and utilization of EFQM model versus BM companies?	<p>The benefits and challenges of ESSQ integration and utilization of EFQM model</p> <p>The ESSQ management maturity level in the case company compared with the leading international BM companies operating in the field of the steel industry</p> <p>Exploitation of the OPEX and BE operating models obtained through benchmarking in the ESSQ management of the case company</p> <p>Generic ESSQ management operating models OPEX and BE</p> <p>Creating new knowledge on how to utilize maturity (EFQM and Toddlergrade) models in Integrated ESSQ</p>

The contributions of this dissertation benefit industrial companies in particular. Individual studies presented in the research articles can also be utilised outside industrial companies, one by one or all together. Companies will be able to develop their own ESSQ management by taking advantage of the view related to ESSQ management presented in this dissertation. If an innovative company fully comprehends the importance of structural change in the market environment to its own position, it can find a way to influence the change in the field in a way that is favourable to its operations; either by choosing how to react to the strategic changes made by its competitors or by commencing strategic changes in its own operations. The company can also influence the change by being as sensitive as possible to external factors that may cause changes in development in its field of business. The development of a field of business should not, however, be seen as a situation to which one reacts – it should be seen as a new business opportunity.

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Original publications

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