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Integrating EMS into SCM

A Case Study of Methods, Benefits and Barriers at Sandvik Tooling

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ABSTRACT

Purpose – The aim of this research is to explore the benefits and barriers of integrating EMS to SCM in Sandvik Tooling. While exploring that, it is intended to gain insights into the methods employed to integrate the systems and find out the type of integration used in practice.

Design/methodology/approach – Explorative case study method is employed in this research paper. Primary data is obtained through semi-structured interviews and observations. Triangulation, respondent validation, peer review are the principal strategies employed to ensure validity and reliability of this study.

Findings – Sandvik Tooling employed a composite view of integration in which verbal and documented forms of information exchanged together with novel solutions to provide integration throughout supply chain on the basis of common goals and vision, shared values and resources. Integration is provided with a balanced mixture of interactions and collaborations. Benefits of integration are categorized as environmental, economic, and organizational benefits. On the other side, barriers are presented as internal and external barriers.

Practical Implications – This research paper has significant practical contributions to businesses with presenting the ways to integrate and analyze these two systems and demonstrate barriers to overcome and benefits to take advantage of.

Originality/value – Environmental management systems and supply chain management topics received considerable interest among researchers in recent decades. However there is a lack of research about how these two systems can be integrated and what kind of integration will best define this integration type. Analyzing barriers and benefits of integration process will also advance and contribute our knowledge in this research area.

Keywords Supply chain management, Environmental management system, Integration, Barriers, Benefits

Paperwork Research paper

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LIST OF ABBREVIATIONS

BS	British Standards
BSC	Balanced Scorecard
CSCMP	Council of Supply Chain Management Professionals
DC	Distribution Center
EC	European Council
EHS	Environment, Health and Safety
EMAS	Eco-Management and Audit Scheme
EMS	Environmental Management System
ERM	Enterprise Risk Management
FMCG	Fast Moving Consumer Goods
GDP	Gross Domestic Product
GSCM	Green Supply Chain Management
HR	Human Resource
IEIMS	Integrated Environmental Information Management System
ISO	International Organization for Standardization
IT	Information Technology
KPI	Key Performance Indicator
OECD	Organization for Economic Co-operation and Development
R&D	Research and Development
ROCE	Return on Capital Employed
SBSC	Sustainability Balanced Scorecard
SCM	Supply Chain Management
SME	Small and Medium Sized Enterprises
UNEP	United Nations Environment Programme
U.S.	United States

1. INTRODUCTION

In introduction section, a brief summary of the research problem and the need for the research will be presented. After justification of empirical research conducted, the structure of the thesis will be illustrated in order to give a quick review of overall study.

1.1. BACKGROUND

1.1.1. Environmental Concerns

Most recent environmental phenomena that are observed prove the fact that climate change is a major challenge the world has ever seen. Shifting weather patterns that cause the calamitous ends, ice loss from glaciers and ice sheets which led finally to contamination of coastal freshwater reserves, increased levels of greenhouse gas emissions and irreversible changes in major ecosystems all awaiting as urgent global threats that have to be tackled by common sense (UNEP, 2010). So, what might organizations do to stem the adverse effects?

Enterprises play a leading role in reversing the process and they shall adapt environmental management systems for a more systematic approach to increase their environmental performance (OECD, 2005).

1.1.2. Role of Responsible SCM for a Better Environment

Supply Chain Management includes an extensive influence area from suppliers' suppliers to customers' customers as well as intermediaries such as transportation companies, distributors, retailers, etc. (CSCMP, 2009; Cooper, et al., 1997). As a result, incorporating green motives into SCM can have far-reaching influence throughout supply chain.

Besides its significance for business, SCM has a pivotal role for environment. Shukla, et al. (2009) claims that most of the environmental deteriorations can be attributed to organizations operate throughout supply chains. Hence, authors suggest incorporating green motives into supply chain in order to curb environmental impacts caused and resulted from SCM. As Green Supply Chain Management (GSCM) incorporates procurement, manufacturing, warehouse management, final distribution and customers (Hervani, et al., 2005; Srivastava, 2007; Shukla, et al., 2009), its far-reaching effects play a key role in environmental management.

1.1.3. ISO 14001: a key instrument in environmental management

ISO 14001:2004 is an international standard that provides guidelines for establishment, implementation and continual improvement of Environmental Management System (EMS) on the basis of Plan-Do-Check-Act (PDCA) cycle, as shown in figure 1.4.

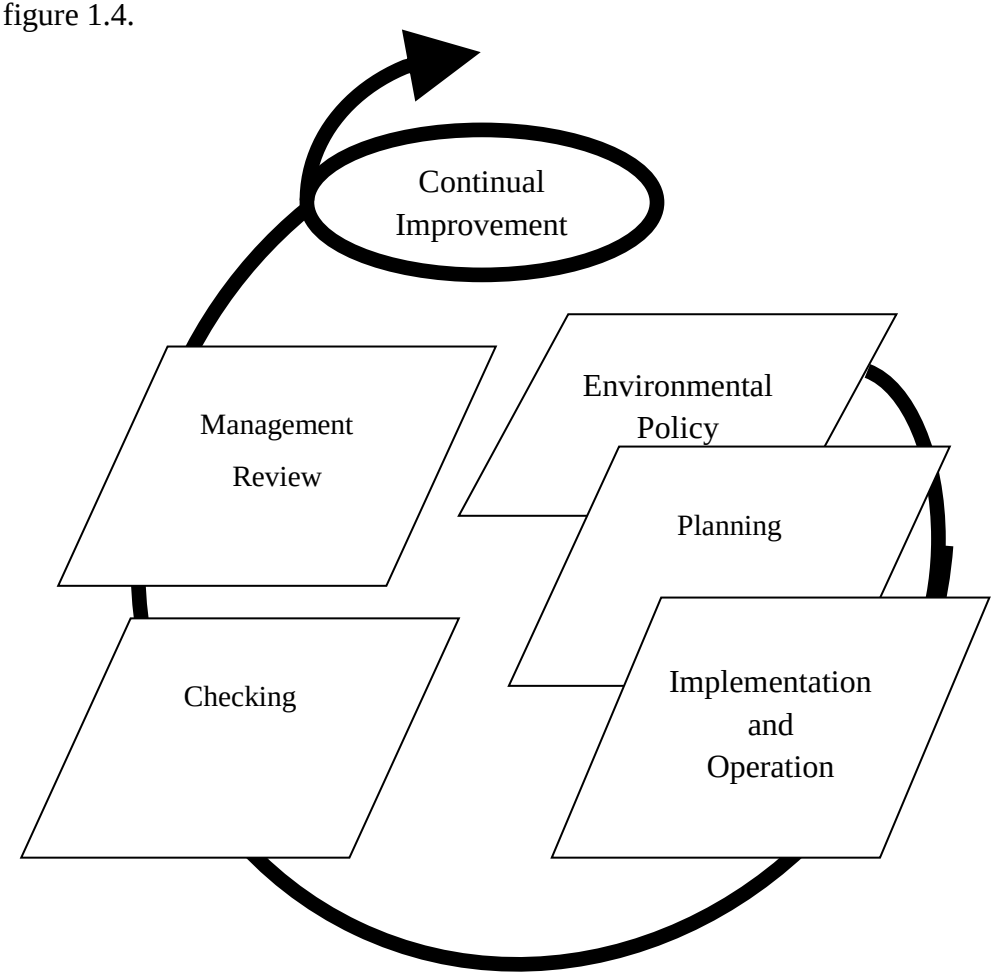


Figure 1.1: EMS model for ISO 14001

Source: ISO 14001: 2004

ISO 14001 aims to achieve continuous environmental performance as showed in figure 1.4; however standard does not oblige members to achieve certain levels of environmental performance (ISO 14001: 2004).

According to statistical data collected by ISO (2009), ISO 14001 was most implemented EMS by 223149 organizations all around the world. ISO 14001 specifies requirements for systematic management of organization's environmental aspects and impacts in line with environmental policy, objectives and targets that are defined due to subscribed legal and other requirements. (ISO 14001: 2004).

1.1.4. Closing the Gap: Why do we need this research?

Environmental issues gained more attention among companies and organizations with the increased awareness and concerns of general public, stricter laws and

regulations and economic and other influences (Brorson & Larsson, 2006). To put it in a nutshell, it has become an imperative for companies to integrate EMS to their management philosophy.

Council of Supply Chain Management Professionals (CSCMP, 2009) defines SCM as below:

> *"Supply Chain Management is an integrating function with primary responsibility for linking major business functions and business processes within and across companies into a cohesive and high-performing business model. SCM includes all of the logistics management activities as well as manufacturing operations, and it drives coordination of processes and activities with and across marketing, sales, product design, finance and information technology."*

Above definition implies a holistic management philosophy that strives to achieve maximum efficiency with minimum waste. Environmental Management Systems (EMSs) reflects a wider perspective as well. Organizations shall define their environmental aspects with all their associated impacts and drive coordination amongst departments for an effective means of management to decrease adverse effects. The philosophy of eliminating waste throughout supply chain fits in well with environmental management systems. Therefore, Green Supply Chain Management (GSCM) has long been a popular research topic for several academicians (Hervani, et al., 2005; Holt & Ghobadian, 2009; Lee, 2008; Mollenkopf, et al., 2010; Shukla, et al., 2009; Srivastava, 2007; Vachon & Klassen, 2006; Zhu, et al., 2010; Zue, et al., 2007). However, barriers and benefits of integrating EMS to SCM have never been discussed in literature. This explorative case study will have practical implications for the businesses to gain insights into the barriers and benefits of integrating EMS to SCM. In addition, descriptive nature of case will demonstrate the type and means of integration which will enlighten the way for businesses willing to follow the same path as well.

In brief, there is an increasing pressure for companies to integrate EMS into their daily operations and in a broader perspective to their management philosophy and this study will guide them what barriers they might face during the EMS integration to SCM process and what benefits this integration will bring as a result.

1.2. PURPOSE

1.2.1. Aim of Research

The aim of this research is to explore the benefits and barriers of integrating EMS to SCM. While exploring that, it is intended to gain insights into the methods employed to integrate the systems and find out the type of integration used in practice in Sandvik Tooling. In figure 1.2, the aims of research are illustrated in a systematic order that took place during investigation. Methods employed by case company revealed the type of integration. In the light of this information, barriers and benefits of integrating EMS to SCM explored.

Figure 1.2: Three stages towards research objectives

Source: The author

1.2.2. Research Questions

Research questions form the basis of research study and crystallize the associated case study method employed by researchers (Yin 1994, 2009). Walliman (2005) also acknowledges the fact by underlying the importance of research questions as the basis of research problem formulation and the scientific approach employed by the researcher. Meriam (2009) argue that research design must correspond with research questions. Research questions, which are listed below, leaded the way for the theoretical foundations of study and paved the way for the research design.

1. How EMS be integrated into SCM?
2. What are the benefits of integration process?
3. What are the barriers of integration process?

All questions are posed to present the central pillars of exploratory case study.

1.3. THESIS DISPOSITION

The structure of this study is demonstrated in figure 1.3. It is structured to enable readers easily follow up the research process. In first part of study, research topic is introduced and the background and need for this research represented. In second part, aims of the study and research questions followed through. In methodology part, author explains readers the research approach, research strategy, data collection methods and discusses validity, reliability, ethics, scope and limitations of study. Theoretical framework part designed to make readers familiar with concepts, theories and analytical models. In description and findings part, case study Company, methods used to integrate systems, the type of integration and benefits and barriers of integrating EMS to SCM presented. In analysis and discussion part, findings and description part analyzed and discussed according to purpose and research questions represented in second part. Author also discussed how the research findings support and/or contradict the previous studies. In final part, conclusions have been drawn from findings and recommendations provided for further study.

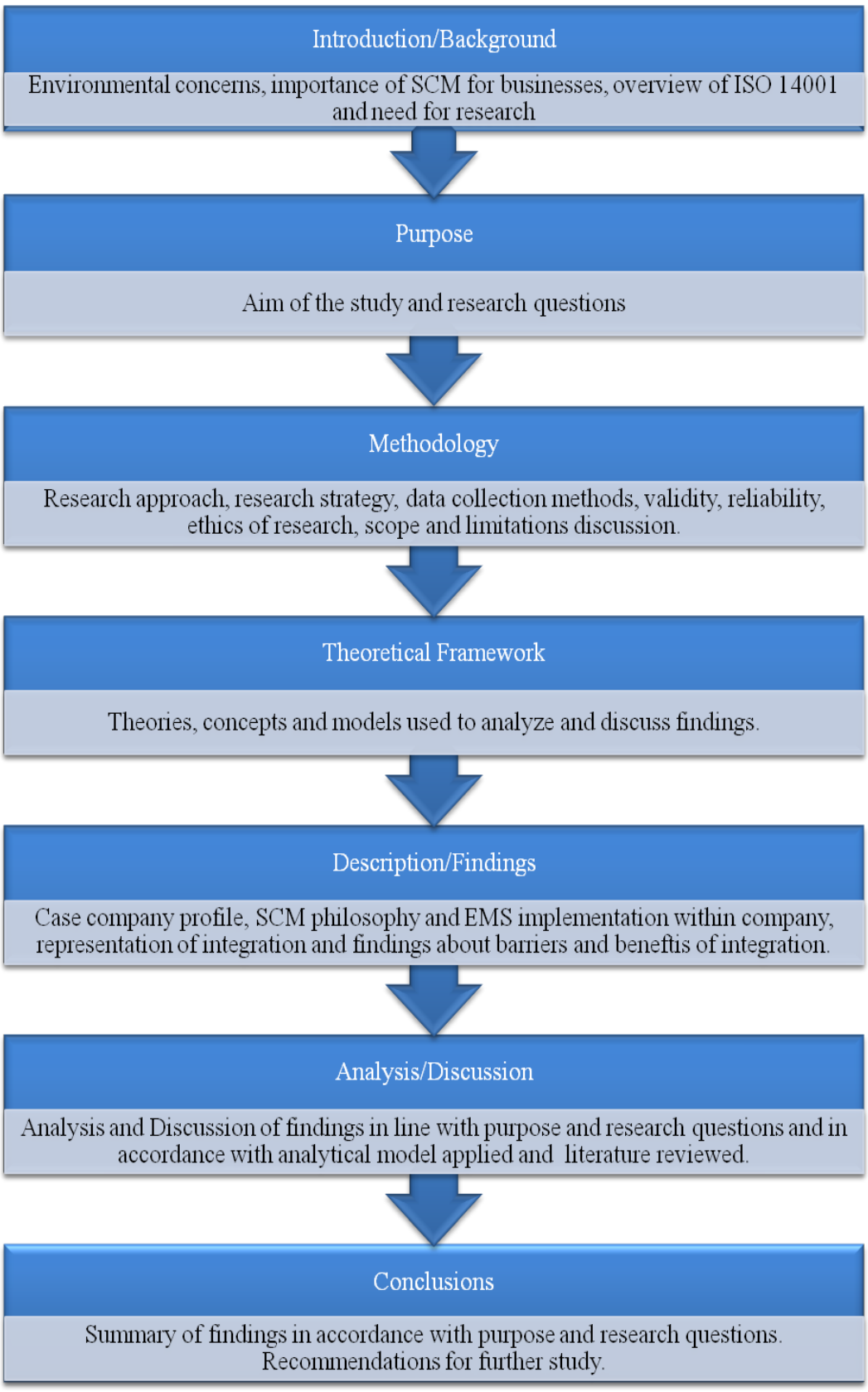


Figure 1.3 Thesis Dispositions

Source: Author

2. METHODOLOGY

According to Trochim (2006) methodology is the way we come to know the world in practice while epistemology is philosophy of that practice. In this part of study; research, research approach, research strategy, data collection methods, validity and reliability issues, research ethics and delimitations are discussed in details.

2.1. SCIENTIFIC RESEARCH

"Research is a combination of both experience and reasoning and must be regarded as the most successful approach to the discovery of truth…" (Borg, 1963 cited in Cohen, et al., 2007, p. 7). Walliman (2005, p. 11) describes three characteristics of a research, that distinguish it from experience and reasoning, as its systematic and controlled nature that oppose to haphazard and uncontrolled nature of experience, empirical nature supported by experiences and observations contrary to the abstract world of reasoning and unlike reasoning and experiences validity and reliability are the basic indicators of quality of research. In this empirical research, inductive reasoning approach employed on the basis of an explorative case study. Validity and reliability of research is discussed in details.

According to Merriam (2009) there are two generic research types that are conventionally categorized as basic and applied research. Basic research intends to increase the awareness and knowledge about a phenomenon. Some of the documentaries might be good examples for basic research. On the other hand, applied research is conducted to enhance the practice in a particular field. This study falls into second category with its practical implications for organizations.

2.2. RESEARCH APPROACH

Research is designed considering different approaches which are complementary and interrelated. In this study, qualitative method employed through inductive process in line with interpretive perspective.

2.2.1. Positivist versus Interpretive Approach

Positivist approach recognizes that science is deterministic and only can be related to things that we can observe and measure (Trochim, 2006). Author states that in positivist approach, reality exists naturally and can only be examined through objective researchers who put aside their biases and beliefs. Theories are tested through empirical research and based on deductive research process. On the other hand; in interpretive paradigm, theory is constructed inductively on data collected from sources that relies on subjective interpretations and experiences (Cohen, et al., 2007). This study relies on interpretations, perception and experiences of people who are experts in their field and main endeavor is to understand the subject from their view of point.

2.2.2. Quantitative versus Qualitative Research Approach

Objectivity is distinctive feature of a quantitative research. Researcher set out scientific inquiry objectively with keeping in mind he/she cannot have any

influence on totally independent facts (Adolphus, n.d.). On the other hand, subjectivity characterizes qualitative research method. Principally, qualitative research relies on participants' experiences, perceptions of their environment, the way they make sense of their observations and their interpretations of knowledge they have (Merriam 2009; Cohen, et al., 2007; Denzin & Lincoln, 2005). It is also possible to combine two methods during execution of a scientific inquiry (Walliman, 2005; Denzin & Lincoln, 2005).

Merriam (2009) compares two methods below in table 2.1.

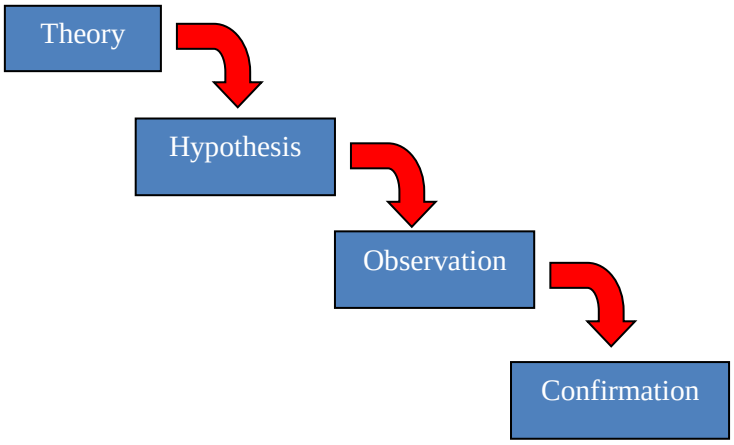
Table 2.1: Characteristics of Qualitative and Quantitative Research (Merriam 2009, p. 18)

Point of Comparison	**Qualitative Research**	**Quantitative Research**
Focus of Research	Quality (nature,essence)	Quantity (How much, how many)
Philosophical Roots	Phenomenology, symbolic interactionism, constructivism	Positivism, logical empiricism, realism
Associated Phrases	Fieldwork, ethnographic, naturalistic, grounded, constructivist	Experimental, empirical, statistical
Goal of Investigation	Understanding, description, discovery, meaning, hypothesis generating	Prediction, control, description, confirmation, hypothesis testing
Design Characteristics	Flexible, evolving, emergent	Predetermined, structured
Sample	Small, nonrandom, purposeful, theoretical	Large, random, representative
Data Collection	Researcher as primary instrument, interviews, observation, documents	Inanimate instruments (scales, tests, surveys, questionnaires, computers)
Primary Mode of Analysis	Inductive, constant comparative method	Deductive, statistical
Findings	Comprehensive, holistic, expansive, richly descriptive	Precise, numerical

From above table, we can conclude that qualitative research is best suited to interpretive perspective and inductive reasoning. In this exploratory study, sampling is purposive and based on smaller scales. Moreover; interviews, observations and documents are the sources of data gathering. Primary data relies on basically on participants' interpretations, experiences and knowledge which are gathered through semi-structured interviews.

2.2.3. Inductive versus Deductive Approach

Walliman (2005, p.10) defines reasoning as *"...a method of coming to conclusions by the use of logical argument."* There are two main methods of reasoning employed by researchers; deductive and inductive reasoning (Walliman 2005, Trochim 2006).



Deductive reasoning starts with a general theory then narrowed down to hypotheses that are tested via more specific observations. Finally, hypotheses are confirmed through specific data or denied (Trochim, 2006).

Figure 2.1: Deductive reasoning

Source: Trochim (2006).

On the other hand, Inductive reasoning starts with specific observations that lead to broader generalizations and theories (Trochim, 2006). Primarily, inductive reasoning tends to be exploratory and open-ended in nature (Trochim, 2006). In this exploratory study, primary and secondary data collected from multiple sources which leaded us conclusions and theory. Therefore, this study followed inductive process and developed theory according to collected data.

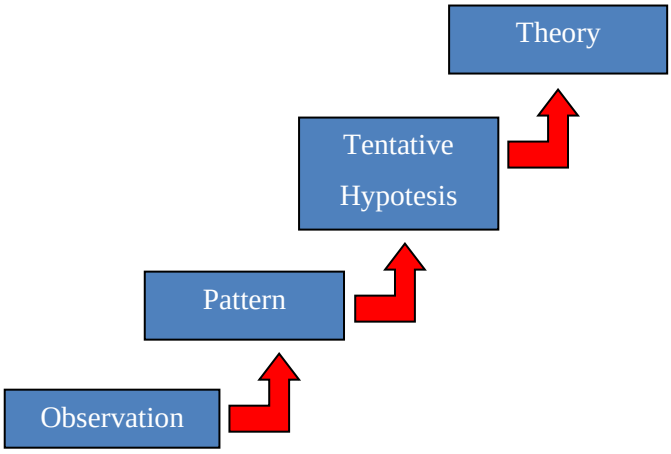


Figure 2.2 : Inductive Reasoning

Source: Trochim (2006).

2.3. RESEARCH STRATEGY

Walliman (2005) identifies five main types of research (research strategies or methodologies, as they are often termed) as experimental, survey, archival analysis, historical and case study. In this study, case study method is employed.

2.3.1. Case Study Research

Yin (2009, p.18) defines case study as *"... an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident."* Case study mainly copes with a contemporary phenomenon which distinguishes it from historical research and while experimental researches limit the variables and create a controlled environment, case study inquiry investigates the phenomenon within its real-life context (Yin 1994, 2009). The vast amounts of variables in the context of a case study require collection of data from multiple sources, validation of data by triangulation and construct a well-planned theoretical base that will guide data collection and analysis (Yin 1994, 2009).

Yin (1994, 2009) classifies types of case study methods in three categories; exploratory case study, descriptive case study and explanatory case study. Explanatory case study is appropriate for explaining the complex presumed causal connections in their real life context (Yin 1994, 2009). Descriptive case study is employed when the study relies on a preliminary theoretical model and describes the characteristics of a phenomenon and its real-life context (Yin 1994, 2009). Researchers prefer exploratory case study when a contemporary vague empirical inquiry with unforeseeable set of outcomes is being investigated (Yin 1994, 2009).

In this study explorative case study research is employed. This study explores the benefits and barriers of integrating EMS to SCM. Prior to this study, the barriers and benefits of integration of two systems have never been investigated. At the beginning, the research had no clear and single set of outcomes based on any theoretical model. Therefore, this research can be considered as a prelude to possible further researches. On the other hand, the case study has a descriptive nature as well. Integration process is described depending on a previous theoretical model developed by Kahn and Mentzer (1996, 1998). Research investigated what type of integration exists between systems and how the case company integrates these two systems.

Yin (2009) elucidates five rationales for single-case studies; it can be a critical case that tests a well formulated theory, it can be an extreme or unique case that explores rare events, it can be a revelatory case when researcher has the opportunity to observe and analyze a case that was inaccessible before, it can be longitudinal case in which phenomena investigated in at least two different time period, and the fifth one is representative or typical case study that exemplifies the similar cases. The case studied in this research falls into fifth rationale. Sandvik Tooling exemplifies a typical globally operating manufacturing firm that strives to integrate environmental management system into supply chain activities. Other manufacturing firms may draw inferences from lessons learned and practical implications can promote to facilitate integration processes for similar cases.

2.4. PRIMARY DATA COLLECTION

This research draws on interviews and observations as primary sources of data.

2.4.1. Sampling Technique

Research population is defined by Walliman (2005, p.276) as *"... a collective term used to describe the total quantity of cases of the type which are the subject of your study."* It may consist of a specific industry, geographical area, gender, consumer market, etc. depending on the research subject that is investigated. However, there are some factors such as expense, time, accessibility, etc. that prevent researchers from investigating the whole population (Cohen, et al., 2007). Therefore, researchers have to collect data from a smaller subset or group that will represent the whole population which is called *"sampling"* (Cohen, et al., 2007). In non probability sampling, population is selected according to some factors rather than random selection (Trochim, 2006). In this study, Interviews are conducted with Mrs. Karlsson who is responsible for proper implementation of EMS in Sandvik Tooling and Mr. Sörlien, in charge of order to delivery. Purposive research sampling has been chosen deliberately after introducing research topic to company and asking for most relevant people who will represent the whole (Trochim, 2006). Hereby, key informant technique is used as sampling involves experienced people who have specific and robust knowledge in their field (Trochim, 2006).

2.4.2. Interviews

According to Kvale (2007, p. 1) scientific interview is a method of knowledge creation during the interaction between interviewer and interviewee. Interviews recognized as major sources of case study information (Yin, 2009). (Kvale (2007) delineates seven stages of an interview inquiry as shown in figure 2.3. In this study, the same order followed in interview research.

After clarifying the purpose and appropriate research method, author decided to do semi-structured interview with a Swedish manufacturing company which implements an environmental management system that is integrated to supply chain management. After discussing our purpose and method with our supervisor, we decided to conduct semi-structured interviews in Sandvik Tooling. Company adopted EMS in 1999 (Karlsson, 2010) and has a profound SCM philosophy. After communicating research topic, purpose and employed method to contact persons provided by supervisor, it's decided to do interviews with Mrs. Karlsson who is responsible for proper implementation of EMS in Sandvik Tooling and Mr. Sörlien, the responsible person for Order to Delivery. Author interviewed with interviewees in their offices at a scheduled time to ensure a comfortable environment. Prior to interviewing, author informed interviewees about the topic and aim of research. Both interviews took around two hours and later supported by e-mail interviews. Author recorded interviews by tape recorder with the consent of interviewees. Author sent the completed work to case company for further confirmation of interviewees to avoid misinterpretations.

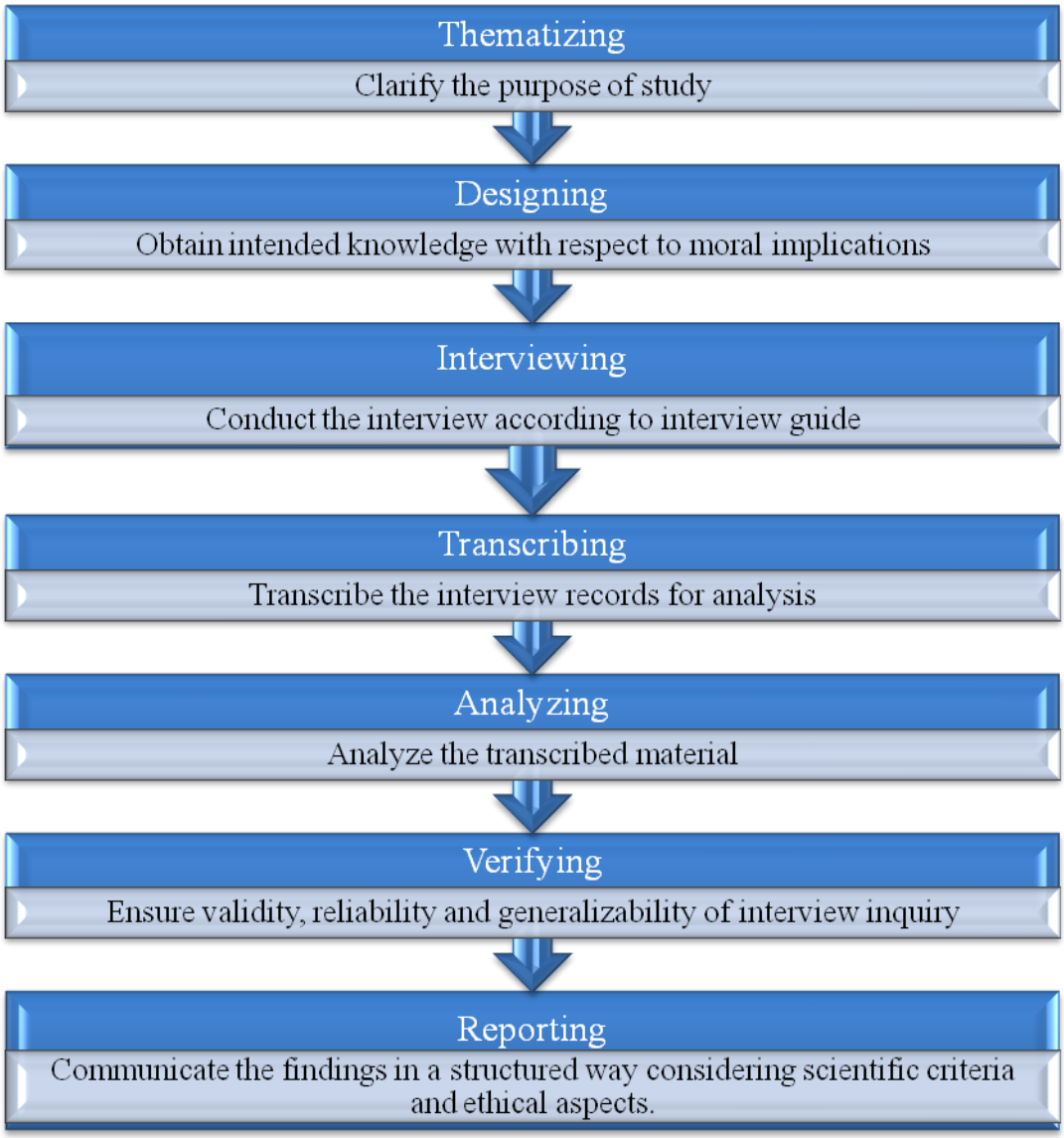


Figure 2.3: Seven stages of an interview inquiry

Source: Kvale (2007, p. 35).

Merriam (2009) outlines three types of interviews in terms of how they are structured as structured interviews, semi-structured interviews and unstructured interviews. Structured interviews based on predetermined questions and the highly structured ones may be defined as oral form of a written survey (Merriam, 2009). Structured interviews are conducted in a standardized form and mostly aim to get responds for specific preconceived notions. In unstructured interview, there is no predetermined set of questions and mostly researcher has little information about phenomenon. Unstructured interviews mostly conducted by highly experienced and skilled researchers to gather enough information for subsequent interviews (Merriam, 2009). Semi-structured interviews are based on a mixture of both predetermined questions and spontaneously asked questions in the course of interview (Merriam, 2009). In this study, semi-structured interview method is employed. Structured questions asked to get specific information such as

interviewee's experience in the field; position, responsibilities and questions regarding how integration is provided between departments, etc. (see Appendix A). On the other hand, some questions asked according to spontaneous statements given by participants to be able to get deeper knowledge about the topic. Author strived to keep biases and preconceived ideas out of exploration phase in which there was little knowledge.

Interviewees played the role of *informants* rather than being just respondents (Yin, 2009). Author got significant insights and understandings with the help of interviewees. Key informants supplied corroborative sources of evidence such as documents from intranet. Author also got the chance to confirm and further discuss about different sources of information. Interviews took place in an extended time period including face to face interviews and e-mail interviews. In the light of all those facts, we can conclude that this interview falls into in-depth interview category that is conducted with key informants as described by Yin (2009).

2.4.3. Observation

Cohen, et al. (2007) argues that observations have the capability to provide more authentic and valid data than mediated and inferential methods. According to Yin (2009), contemporary nature of cases might allow direct observations. Yin (2009) describes two types of observation as direct and participant's observation. In direct observations, researcher does not have any active role in the case being studied. In participant's observation, observer participates in the events and takes an active role. In this study, direct observation method is employed.

EMS implementation within case company is a continual process. Thus, it is possible for researchers to observe the process on different time intervals. Author had the opportunity to observe how the case company collaborates with customers for recycling processes during interviews. While a box is used to collect inserts and solid carbide tools, there are two different boxes used to transport materials separately. Cutting tool inserts are recyclable and designed to provide improved productivity. Author gained insights about how the information is shared throughout the supply chain via intranet through direct observations. Materials that are used to increase environmental awareness and information also observed during interview (Karlsson, 2010). Moreover, author visited places where annual meetings are held and education for environmental management system is provided.

2.5. SECONDARY DATA COLLECTION

According to Crowther & Lancaster (2008) secondary data is previously used data that aimed to solve a different research question and can serve researchers in a variety of ways such as identifying the problem and setting objectives, developing an approach to the problem, formulating appropriate research problem, answering certain research questions and helping interpret primary data. In this study, secondary sources of data served to the research in all these ways indicated by Crowther & Lancaster (2008, p. 91).

Walliman (2005, p.274) identified main sources of secondary information as libraries and archives, museums and collections, government departments and commercial/professional bodies, internet and the field. Secondary sources of data collected basically from scientific articles, books, dissertations, standards and regulations, reports, newsletters, presentations, official websites, Google Books and conference papers. In addition, author observed how Sandvik Tooling's engineering technology is developed over time and how that promotes increased customer productivity during the visit to museum located at the headquarters of the firm.

Scientific articles mostly searched from online fulltext databases subscribed by Library of University of Gävle. Author also extracted data from official websites of case company, associations and organizations; Sandvik AB (www.sandvik.com), Jernkontoret (Swedish Steel Producers' Association) (www.jernkontoret.se), United Nations Environment Programme (UNEP) (www.unep.org), Organization for Economic Co-operation and Development (OPEC) (www.oecd.org), and International Organization for Standardization (ISO) (www.iso.org).

2.6. VALIDITY AND RELIABILITY

Cohen, et al. (2007) defines many types of validity. Construct validity, internal validity and external validity are the most commonly explicated ones by scholars (Yin, 2009). Construct validity refers to the extent to which researcher's constructions of a particular issue are supported by literature (Cohen, et al., 2007). Scholars also underline the importance of counter examples that are given in balance with supporting theoretical base. Internal validity is assured if the research findings correspond to the reality (Merriam, 2009). Do findings represent what really happens? External validity refers the applicability of results to the bigger sample sizes, populations or cases (Cohen, et al., 2007).

In qualitative research, reliability refers to the extent to which results are consistent with the data collected (Merriam, 2009). Denzin & Lincoln (1994 cited in Cohen, et al., 2007, p. 148) stipulate three ways of addressing reliability concerns in a qualitative research;

- *Stability of observations:* If the research was conducted in a different time or place, will it yield to the same results?
- *Parallel forms:* If the researcher paid attention to other phenomena during the observation, will he/she be able to do the same observations and interpretations?
- *Inter-rater reliability:* If the phenomenon is observed with another researcher with the same theoretical grounds, will he/she draw the same conclusions?

Triangulation, respondent validation, peer review are the principal strategies employed to ensure validity and reliability of this study (Merriam, 2009).

Denzin, (1978) as cited in Merriam (2009, p. 215), described four types of triangulation: multiple sources of data, multiple methods, multiple investigators,

and multiple theories. In this study, the data collected from multiple sources such as interviews, observations and documents such annual report of company, newsletters issued by company, documents issued by ISO, articles relevant to topic and documents issued by EU.

Respondent validation signifies that the researcher takes feedback from participants to avoid misunderstandings and misinterpretations (Merriam, 2009). In this study, author took continues feedback to gain insights about what really meant by participants and to avoid any possible biases.

Peer review was a usual process during the study as supervisor read and commented on each part of the study and provided precious feedbacks (Merriam, 2009). After completing the study, it was also sent to a peer student for review and feedbacks.

2.7. RESEARCH ETHICS

Patton, (2002) as cited in Merriam (2009, p. 233-34), proposes a checklist below when considering ethical issues in a qualitative study:

1. Explaining purpose of the inquiry and methods to be used
2. Promises and reciprocity
3. Risk assessment
4. Confidentiality
5. Informed consent
6. Data access and ownership
7. Interviewer mental health
8. Advice (who will be your counselor on ethical matters)
9. Data collection boundaries
10. Ethical versus legal conduct

Merriam (2009) attach great importance to ethical stance of a researcher. To a large extent, validity and reliability of a study relies on ethical issues (Merriam, 2009). In this study, author considered all ten items listed above. Author informed the interviewees about the purpose and methods that are planned to be employed. Author asked interviewees for the required permissions and determined the limitations during data collection. For example, some of the data from intranet were not allowed to use in this study. Author sent the report to interviewees to avoid possible misinterpretations and biases. Study was conducted with respect to private spaces of interviewees (Stake, 2005 cited in Merriam, 2009, p. 231).

2.8. SCOPE AND DELIMITATIONS

Research is narrowed down to a single case study which involves a Swedish manufacturer that is specialized in cutting tools and systems. Research will reveal

the benefits and barriers of integrating EMS to SCM, what kind of integration exists between two systems and how the integration is provided. *Representative or typical case* set a typical pattern amongst many other manufacturing firms (Yin, 2009).

Data collection, analysis of data and final conclusions heavily rely on researchers' abilities and instincts throughout a case study research process (Merriam, 2009). Author defines further limitations of case study as reliability, validity and generalizability. Triangulation, respondent validation, peer review are employed to ensure validity and reliability in this study. On the other side, representative case study set a typical pattern even though it cannot be fully replicated.

Research findings should be replicated within different cultural contexts in order to be generalized. Swedish steel industry puts environmental considerations in high priority and strives to develop greener technologies (Jernkontoret, 2010) while in developing countries environmental issues are not considered as primary liabilities of steel producers.

There are many companies involved throughout supply chain. Benefits and barriers of integrating EMS to SCM explored from case company standpoint. Research should be dispersed to larger random samples throughout the supply chain to get more accurate results. Investigation could be extended further to the suppliers and customers.

Interviews should be extended to the managers of DCs, manufacturing, purchasing, IT, etc. to get more accurate portrayal of barriers and benefits of integration as SCM involves all these departments.

Decision making process dispersed thorughout company. Environment, Health and Safety Council prepares policies, objectives, targets and measurements. Then Group executive management decides corporate level policies, objectives and measurement which later implemented by business areas together with individual targets, strategies and acitivities. Environmental KPIs later analyzed by Group Assurance and reported to Boards of Directors and Group Executive Management. Therefore, conducting interviews in different levels of managerial processes can bring together more accurate results as perspectives might change from middle managers to higher levels. Author strived to overcome this weakness of study through extensive analysis of company publications in which opinions of executives from different managerial levels were available.

There are some factors such as expense, time, accessibility, etc. that prevent researchers from investigating the whole population (Cohen, et al., 2007). Therefore, researchers have to collect data from a smaller subset or group that will represent the whole population which is called *"sampling"* (Cohen, et al., 2007).

Author strived to support qualitative findings collected through interviews with quantitative data collected through company annual reports, website and other publications.

Ethical constraints on research have caused some limitations in data collection process. Some of the data, that taught to break the competitive intelligence policy of company, was not allowed to be presented in this study.

3. THEORETICAL FRAMEWORK

In this part of study, literature is reviewed to support relevant research area. As it is mostly ambiguous issue, a clear distinction is made between Supply Chain Management and logistics terms. Integration is elucidated to conceptualize in readers' minds what really meant by this research. Then, environmental management systems and barriers and benefits of implementing ISO 14001 presented. Moreover, a link between EMS and SCM formed by GSCM. Finally, Swedish Steel Industry is overviewed from an environmental perspective. Later, theories are used to analyze and discuss research findings.

3.1. SUPPLY CHAIN MANAGEMENT

3.1.1. Description of Supply Chain Management (SCM)

It is our contention that a clear definition of Supply Chain Management (SCM) is vital as it is the main subject of interest. In our study, we will refer to the frequently quoted definition made by Council of Supply Chain Management Professionals (CSCMP, 2009):

> *"Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. "*

CSCMP (2009) state that SCM is a holistic management philosophy that strives to achieve integration horizontally and vertically throughout the entire chain. SCM does not only compromise transportation and inventory management; it goes far beyond linking primary business functions and processes within and across organizations. SCM links the departmental functions within company and synchronizes the chain activities from supplier to final customer with efficient and effective flow of information. Coordination and collaboration increase the efficiency along the whole chain with eliminating duplicate and unproductive use of resources (Bowersox, et al., 2010). Apart from traditional logistics management concept, it requires supplier and customer involvement and integration in the process to obtain optimal efficiency and effectiveness in the entire supply chain (Jonsson, 2008; Ross, 1998). Supply chain management aims to provide maximum efficiency with minimum handling and buffering (Hoover, et al., 2001). The level of integration is determined by the customer segment, geographical location, service, and product ranges (Gattorna, 1998).

Cooper, et al. (1997, p.10) proposes a framework that illustrates the key components, business processes and structure of SCM in figure 4.1. In this illustration, SCM encompasses key business processes such as product development which borders goes far beyond logistics' activities and scope. Scholars state that SCM components are available and common in all business processes and individual chain members. These management components are essential in designing organizational structures and cultures. On the other hand, business functions are integrated within and across companies to avoid possible inefficiencies. There can be trade-offs across departments such as sales & marketing department may find it beneficial to hold buffer stock to respond unexpected customer demands while logistics manager will think it will increase

inventory costs. Another conflict can arise between finance and logistics departments. Logistics department might take the advantage of economies of scales from huge shipment lots while finance department might not be willing to tie up capital. Considering all of the business aspects, management should put forward the pros and cons and take decisions strategically (Hoover, et al., 2001; Lysons & Gillingham, 2003). So basic philosophy is to make compromises and do the best for company and chain benefits. In addition, effective and efficient flow of information and financial components are also essential parts of SCM besides flow of products (Ayers, 2001). Moreover, Ayers (2001) also underlines the importance of knowledge inputs that are included in the system such as new product development or innovation management.

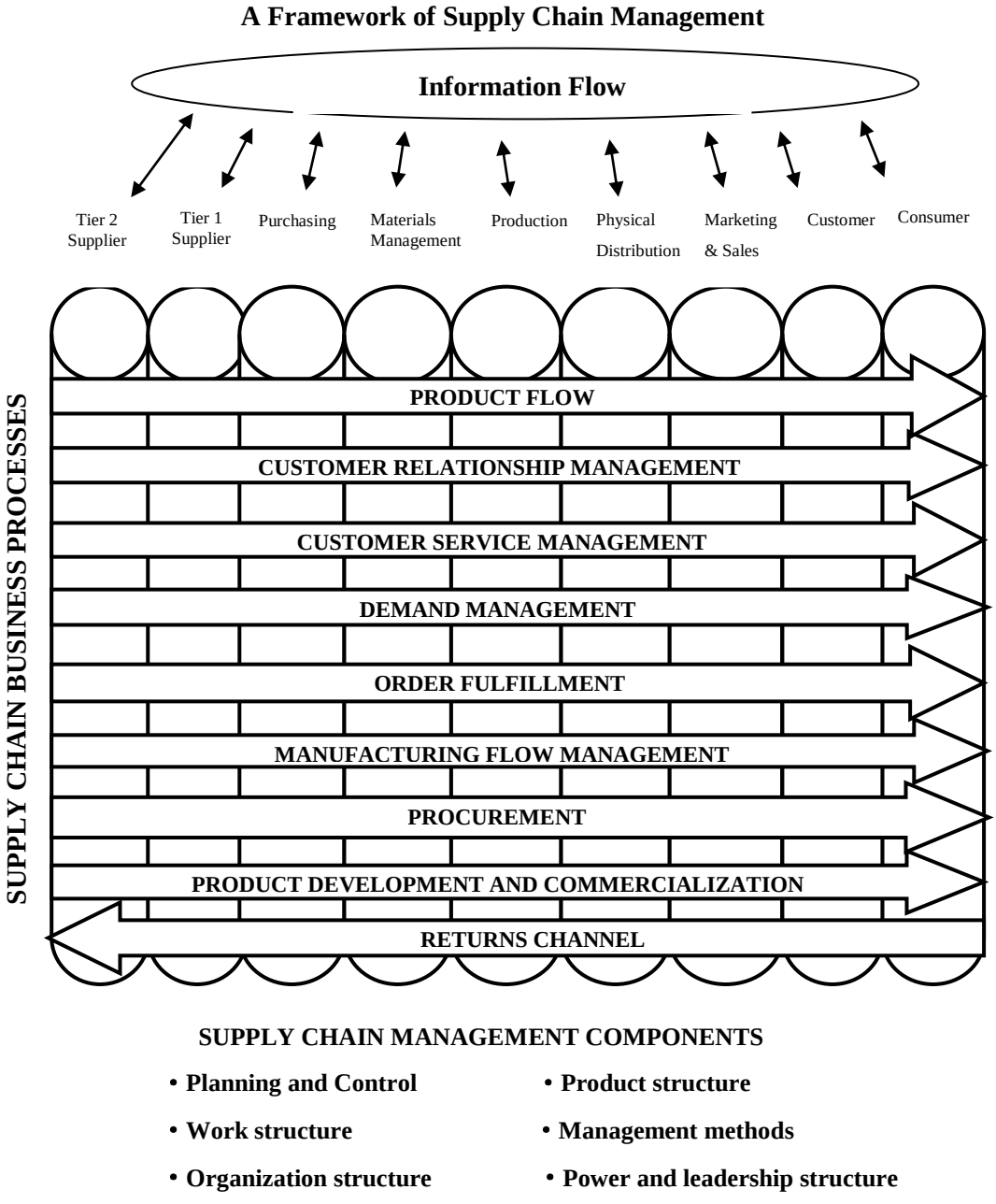


Figure 3.1: A Framework of Supply Chain Management

Source: Cooper, et al., (1997, p. 10).

3.1.2. Logistics Management Concept

The word logistics was first used as a military term in 1905 to imply assurance of armies supply at the right place whenever needed (Christopher, 1998). However, we will refer to the logistics management concept that is used in business environment. CSCMP (2009) defines Logistics Management as:

> *"... part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customers' requirements. "*

CSCMP (2009) definition implies that logistics is strategically management of transportation and inventory activities from suppliers to final customer and on the reverse direction with the most effective and efficient way. Management includes "plan, source, make, deliver and return cycle". Another important term is reverse logistics that is mostly undervalued. However, reverse logistics receives higher recognition with the return of goods mainly from online purchases. It is a key indicator in customer satisfaction. Thirdly, we should underline the importance of flow and storage of related information in the above definition. If companies cannot have the information of in what quantities of goods stored, where they are stored or the tracking and trace of good flow; then it will be impossible to allocate or use resources in an effective and efficient manner. Logistics management also incorporates coordination of logistics activities with other department in order to avoid possible trade-offs. So, one of the logisticians role is to coordinate the activities with other departments managers. All those efforts are made to finally meet the customer requirements with the most efficient way (Murphy & Wood, 2004).

The primary objective of logistics is to provide the desired goods at the right time, at the right place with the expected quality and the minimum use of resources (Ballou, 1999; Christopher 2005). In addition, Rutner and Langley (2000) focus on logistics value that compromises three elements: cost/profit, customer service and quality. This implies all aspects of logistics services including time and place utility that will result in cost reductions, total quality management and most importantly a pretty well organized customer service that finally brings customer satisfaction.

Blanchard (1992) argues a life cycle approach must be developed and employed into logistics definition to reduce total costs. Author claims it will be a cost effective strategy to consider logistical costs in early stages of product/system design and planning.

In figure 4.2 we illustrated a simple version of logistics management and related activities. In below depiction, the information flow is reciprocal to drive higher coordination within and among departments. Logistics management endeavor to provide most efficient communication channels between departments to avoid possible trade-offs. Inbound logistics comprise the transportation and inventory management activities that took place whilst the movement of goods from suppliers to manufacturing. Materials Management implies planning and controlling availability of products with the lowest possible price and highest quality assurance at the scheduled production time. We refer to Rushton et. al.,

(2006) in this illustration that defines materials management as the flow of goods and storage through and into production sites instead of materials management described similar to logistics management in other sources (Arnold, et al., 2008; Gopalakrishnan & Sundaresan, 1977). So, its borders overlap with the borders of outbound and inbound logistics. Outbound logistics is the management of all activities to move and add-value to goods that finally arrives to customer. Figure 4.2 also demonstrates the reverse logistics activities that are key success factors in contemporary business environment. In addition, logistics activities added into illustration for a better comprehension of logistics management. We can conclude that, logistics management incorporates all the aspects related with goods movement from point of origin to final destination with the aim of most effective and efficient use of resources to reach higher customer satisfaction.

LOGISTICS ACTIVITIES AND MANAGEMENT

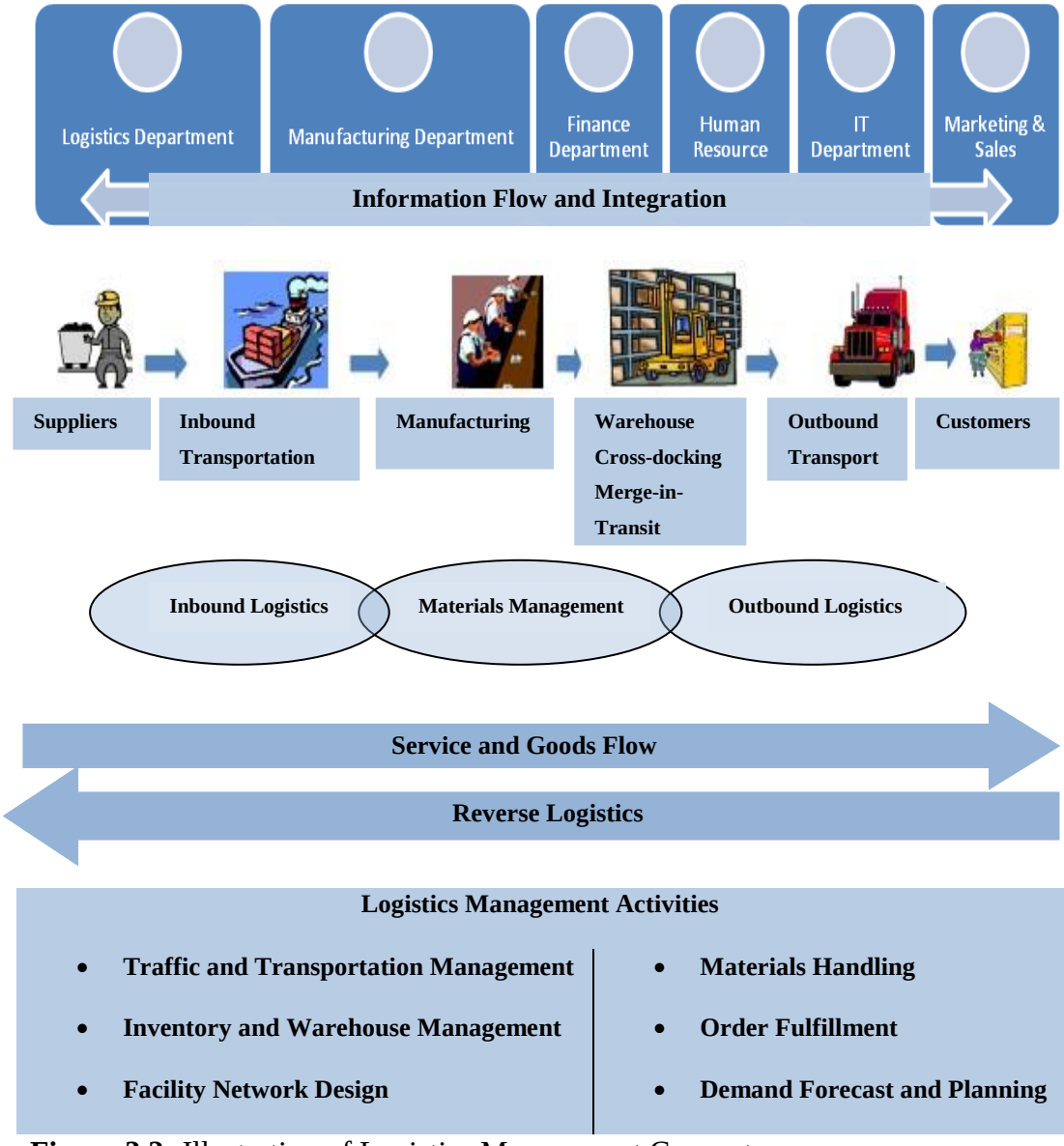


Figure 3.2: Illustration of Logistics Management Concept

Source: Inspired by Descriptions and definitions made by CSCMP (2009); Rushton, et al., (2006); Murphy & Wood (2004).

3.1.3. The Difference between Logistics and SCM

There are different points of view on distinguishing the two terms; Logistics and SCM. Indiscriminate usage of two terms is obscure and often leads confusion, so we found it highly valuable to articulate the difference between two terms. It is still a vague issue even though there are many academic studies due to the arguments and different views asserted.

Bloomberg, et al. (2002) has defined SCM as the process of effective and efficient materials flow management from suppliers to final customer. They add suppliers' management, logistics management and operations into this process. However this definition is relatively narrow in scope and perspective as SCM comprises business processes, business functions and integration and relationship management throughout the whole chain (Cooper, et al., 1997).

According to Rushton, et al. (2006) SCM refer to a broader concept that comprises the upstream (supply side) and the downstream (demand side) partners in the supply chain as indicated in figure 4.3. SCM goes beyond the company boundaries and strategically plans the whole chain activities from suppliers to final customer. In addition; the flow and storage of information and materials carried out with a holistic management perspective considering the tradeoffs. Companies can plan, manage, and control inventories and transportation activities more efficiently and effectively through collaborating with suppliers and customers that lacks in traditional logistics management. Paik & Bagchi (2007) also acknowledges excessive inventory levels caused by bullwhip effect can be avoided and lead times can be reduced through greater information sharing and collaboration among all channel members.

Bowersox, et al. (2010) state that SCM refers to *"acknowledged dependency"* and collaboration to increase the competitiveness and efficiency whilst logistics is the operational effort to position the inventory geographically. Authors signify logistics as a subset of SCM.

Skjøtt-Larsen, et al. (2007) argued that logistics operations take place within corporate boundaries even if they have influence on other firms' operations. However, SCM strategically requires inter-organizational coordination and control left to the specialists beyond the company borders such as liner shipping companies, freight forwarders, customers, suppliers, etc.

Frazelle (2002) distinguishes the two concepts by explaining that the SCM is the environment that consists of all necessary facilities, vehicles and information systems connected by suppliers and customers. Logistics is the operational work that takes place in the supply chain. Author use the metaphor *"arena"* for SCM and *"the game"* played in the arena for the logistics.

Cooper, et al. (1997) emphasizes the importance of integration of business processes in SCM that is coordinated within and across company borders. Authors argue that SCM is a wider concept goes beyond logistics and it is useless to replace these words (Cooper, et al., 1997; Christopher, 2005). However, other scholars claim that logistics and SCM are synonymous terms and SCM is evolved from logistics concept in order to meet requirements of new century (Greenwood, 1997; Coyle, et al., 2003; Enarsson, 2006).

In this study, SCM is considered in a broader perspective; management of all stakeholders and related processes and information flow throughout the whole process, from suppliers to final customers and all intermediaries involved in logistics activities (such as liner companies, truckers, customs agencies, freight forwarders, value added service providers, etc.), including NGOs, media and people who are affected from these processes. Therefore, companies should consider all these stakeholders in planning phase of integration of EMS into SCM.

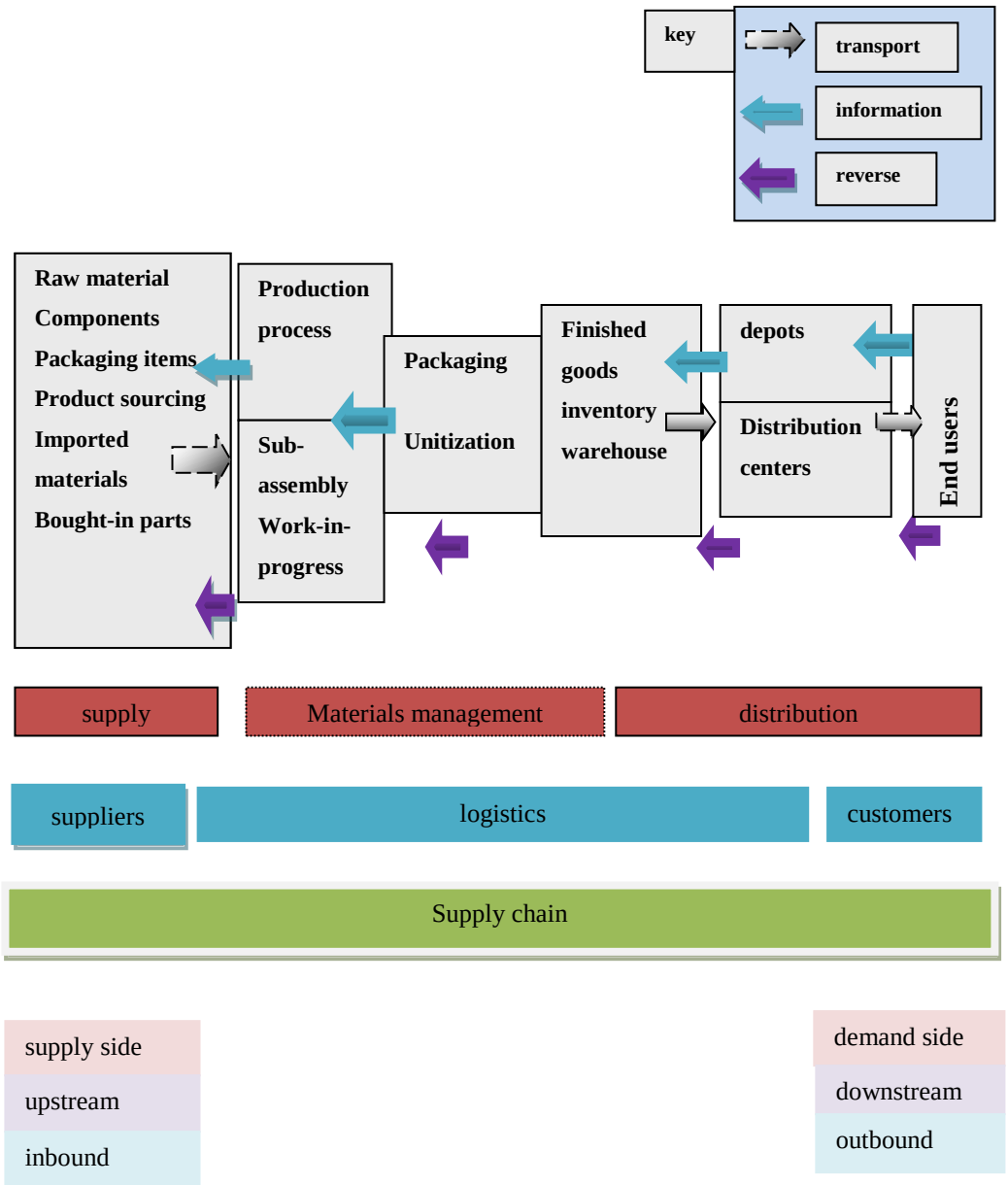


Figure 3.3: A Logistics configuration of an FMCG company showing the key components, the major flows and some of the different logistics terminology

Source: Rushton, et al. (2006).

3.2. ENVIRONMENTAL MANAGEMENT SYSTEMS (EMS)

Environmental Management Systems (EMS) has received increased recognition since 1990s (Steger, et al., 2002). British Standards 7750 (BS 7750) was published as the world's first environmental management standard in March 1992 (Starkey, 1998). Then it is followed by adoption of EMAS on June 29, 1993 by European Council (EC) (Wenk, 2004). Finally, ISO 14001 standards were promulgated in September 1996 (Honkasalo, 2000).

EMS emerged with increasing environmental concerns as a tool to provide systematic approaches to increase environmental performance of the organizations (Hillary, 2004). However there is an ongoing debate on the impact of EMS implementation on environmental performance of organizations (Iraldo, et al., 2009; Melnyk, et al., 2003; Ammenberg & Hjelm 2002; Nawrocka & Parker 2009; Johnstone & Labonne 2009).

Standardized environmental management systems are systematic and structured methodologies to effectively manage environmental issues in line with other management systems within the company (Brorson & Larsson, 2006, p.15). According to Brorson & Larsson (2006), Environmental Management Systems (EMSs) can be grounded on generally accepted fundamental principles which form a cycle to achieve continuous improvement as depicted in figure 3.4

According to figure 3.5 and table 3.1, ISO 14001 certification spread out all over the world with a total of 223149 registered organizations.

Table 3.1: Top 10 Countries for ISO 14001 certificates in 2009 (ISO, 2009)

1	China	55316	6	Korea, Republic of	7843
2	Japan	39556	7	Romania	6863
3	Spain	16527	8	Germany	5865
4	Italy	14542	9	USA	5225
5	United Kingdom	10912	10	Czech Republic	4684

Wätzold, et al. (2001) & Glachant, et al. (2002) suggest that granting regulatory relief to the companies can be major driver for participation in environmental management systems (EMSs). Hillary (2004) writes that customers, regulators and local authorities are the main stakeholders that exert greater influence on adoption of EMS than others. Author state other stakeholders that drives EMS adoption as insurers, general public, suppliers, larger companies and banks.

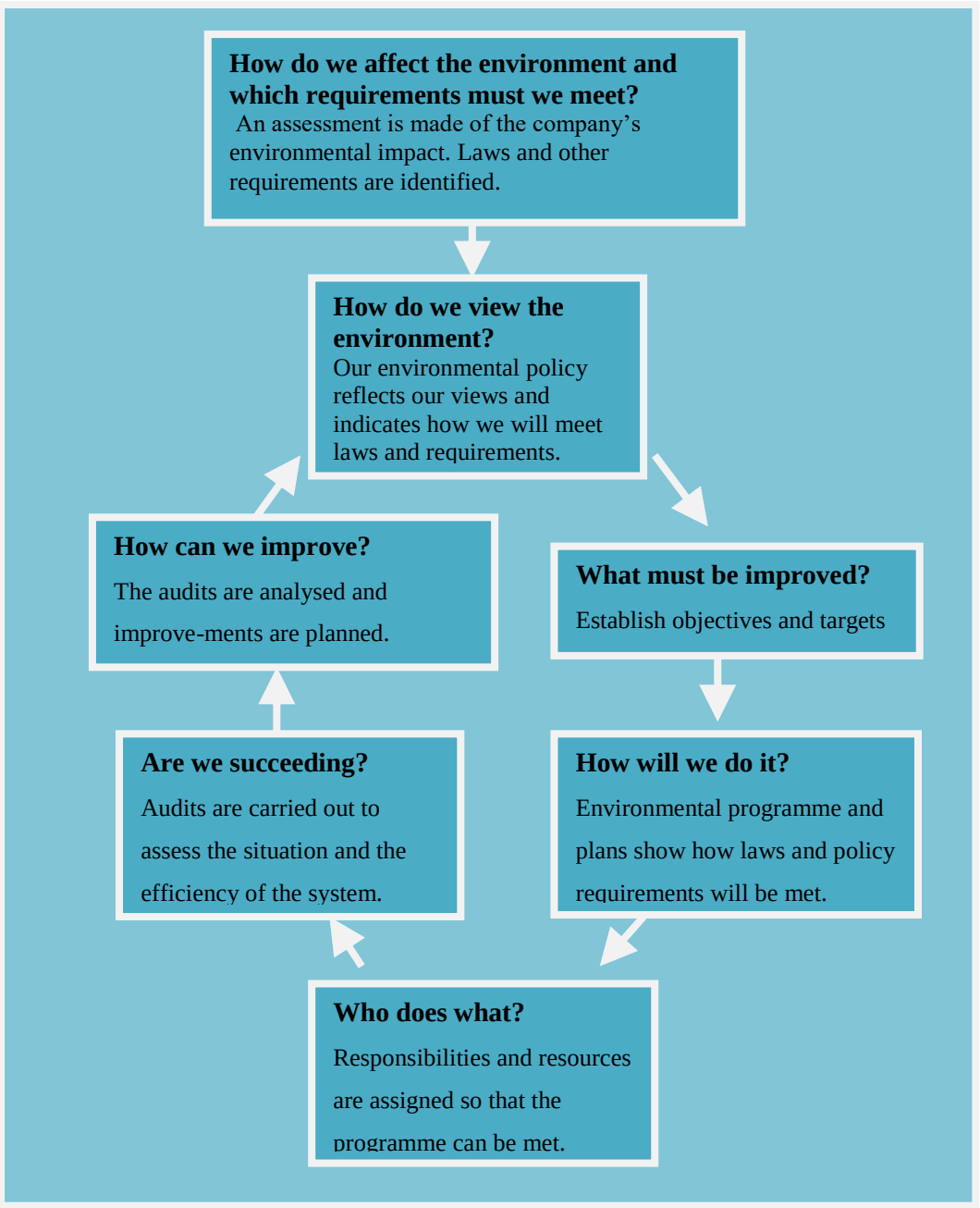


Figure 3.4: Basic Principles of an Environmental Management System

Source: Brorson & Larsson (2006, p.15).

Morrow & Rondinelli (2002) point out ensuring regulatory compliance, enhancement in documentation, environmental performance and awareness and ambition to increase efficiency levels as the predominant impetus for EMS implementation; image, regulatory relief, cost savings and competitive advantage are indicated as other driving forces.

Research conducted by Zhang, et al. (2008) indicates supply chain, customers and community have positive influence on encouraging companies to improve their environmental performances.

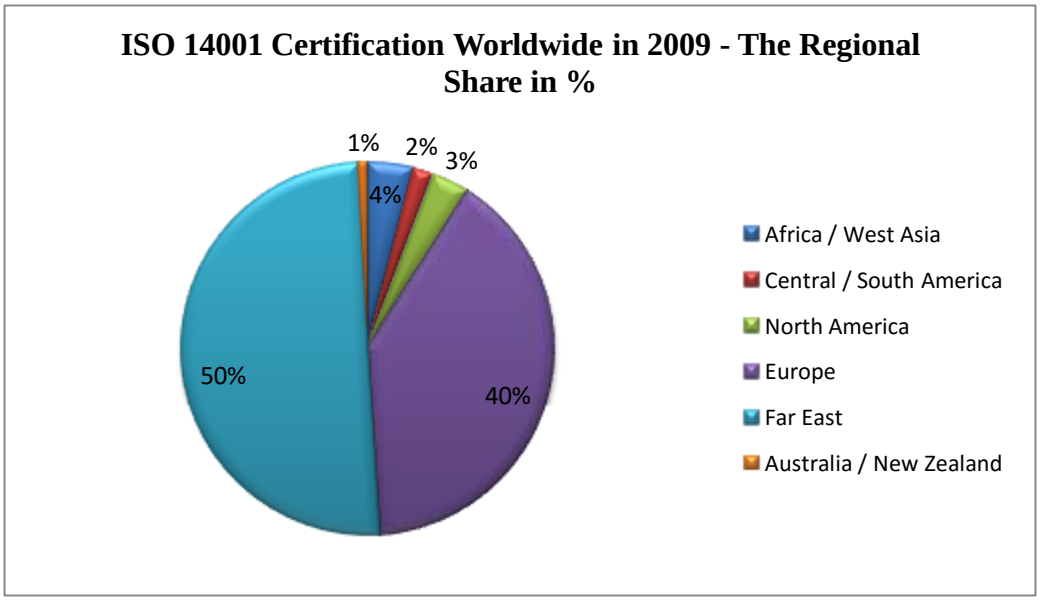


Figure 3.5: The Regional Percentage of ISO 14001 Certified Organizations Worldwide

Source: ISO (2009).

3.2.1. ISO 14001 requirements on Suppliers and Contractors

ISO 14001:2004 clause 4.3.1 requires organizations to "*establish, implement and maintain procedures to identify environmental aspects of their activities, products and services over which they have control or influence."* Moreover; ISO 14001:2004, clause 4.4.6 that explains the requirements on operational control states that organizations shall plan and carry out operations congruously with environmental policy, objectives and targets and one of the step to ensure operations are in line with environmental management system is to communicate the applicable procedures and requirements to suppliers and customers.

Cascio, et al. (1996) argues that ISO 14001 does not entitle organizations to review the environmental aspects of their suppliers or contractors and stipulate what would not be necessarily carried out under ISO 14001 standards as below:

- Ask for key performance indicators of suppliers or contractors regarding significant environmental aspects and impacts.
- Dictate suppliers or contractors to adapt organization's EMS.
- Audit suppliers or contractors to ensure whether they met legal requirements.
- Entail suppliers or contractors to have a registered EMS.

However, Cascio, et al. (1996) highlight the importance of assuring that suppliers and contractors comprehend organizations' environmental requirements so they will not hinder the processes unwittingly. They also add that ISO 14001 does not

require suppliers evaluation but it also not prohibit organizations to do so and/or take further steps.

Whitelaw (2004) proposes organizations to determine the key suppliers and categorize them according to their environmental risk. After that organizations shall develop a purchasing strategy accordingly. Author also underlines the importance of conducting environmental friendly purchasing strategy according to corporate necessities and market conditions.

ISO 14004:2004 which provides guidance on adaptation of ISO 14001 states under clause 4.3.1.3:

"... When evaluating its ability to influence the environmental aspects associated with an activity, product or service, an organization should give consideration to legal or contractual authority, its policies, local or regional issues and its obligations and responsibilities to interested parties. The organization should also consider the implications on its own environmental performance, for example by the purchase of products containing hazardous materials. Examples of situations in which these considerations can apply include activities carried out by contractors or subcontractors, design of products and services, materials, goods or services supplied and used, and the transport, use, reuse, or recycling of products placed on the market."

In ISO 14004:2004 under clause 4.4.6.1, it is stated that:

"An organization should also consider how contractors or suppliers might affect its ability to manage environmental aspects, achieve objectives and targets, and otherwise comply with applicable legal requirements and other requirements to which the organization subscribes. An organization should establish operational controls that are needed, such as documented procedures, contracts or supplier agreements, and communicate them to its contractors and suppliers as appropriate."

We can conclude from above statements that organizations should take into consideration environmental aspects of contractors and suppliers that might have an influence on its own environmental performance.

4.3. CONCEPTUALIZATION OF INTEGRATION

Encyclopedia Britannica defines **integrate** as *"...to form, coordinate, or blend into a functioning or unified whole."* The main concern of integration is to find the best possible ways to combine independent systems to function effectively as a whole. Human body is the best example of that, which is formed by various independent biological systems that are integrated to form a perfect functioning whole.

Skjøtt-Larsen, et al. (2007, p. 20) defines integration as "…*coordination across functional lines and legal corporate boundaries. This coordination may be organizational, e.g. inter-organizational teams and interfaces at various management levels, system-related, e.g. integrated information and communications systems, and Internet connections, or planning related such as exchanges of order data, inventory status, sales forecasts, production plans, and sales and marketing campaigns."*

We will refer to one of the widely accepted definition made by Kahn & Mentzer (1996, p. 9) who define interdepartmental integration as *"... a process of*

interdepartmental interaction and interdepartmental collaboration that brings departments together into a cohesive organization."

Kahn & Mentzer (1996, 1998) and Kahn & McDonough III (1997) ascribe three kinds of integration that are composed of interactions, collaboration and both. Interactions are mainly ensured by meetings and information exchange between departments. Collaboration is achieved through common goals, shared values and team work (Stank, et al., 1999). Third one is a combination of both. According to interaction management philosophy, managers perceive the relations with other departments as transactions. Departments compete for get the best share from company resources to achieve highest departmental success. On the other hand, collaboration philosophy refers to a different managerial perspective that grounded on common values, goals in parallel with ongoing relations to achieve overall success. Managers of departments co-operate for the benefits of whole company. Thirdly, combination of two perspectives requires communication and involvement. Documented information sharing and team oriented task accomplishments are the basis for the third perceptive (Kahn & Mentzer, 1996). In a later study, scholars suggest that firms shall achieve inter-departmental integration through collaboration on common grounds that comprise shared goals, vision, mission, risks, resources and ideas instead of forcing departments to interact through frequent meetings or sharing a great deal of documented information (Kahn & Mentzer, 1998). In addition; they claim that while collaboration has a positive effect on firm's performance, too frequent interaction may be detrimental. In figure 3.6, a model of integration and its effect on performance is depicted.

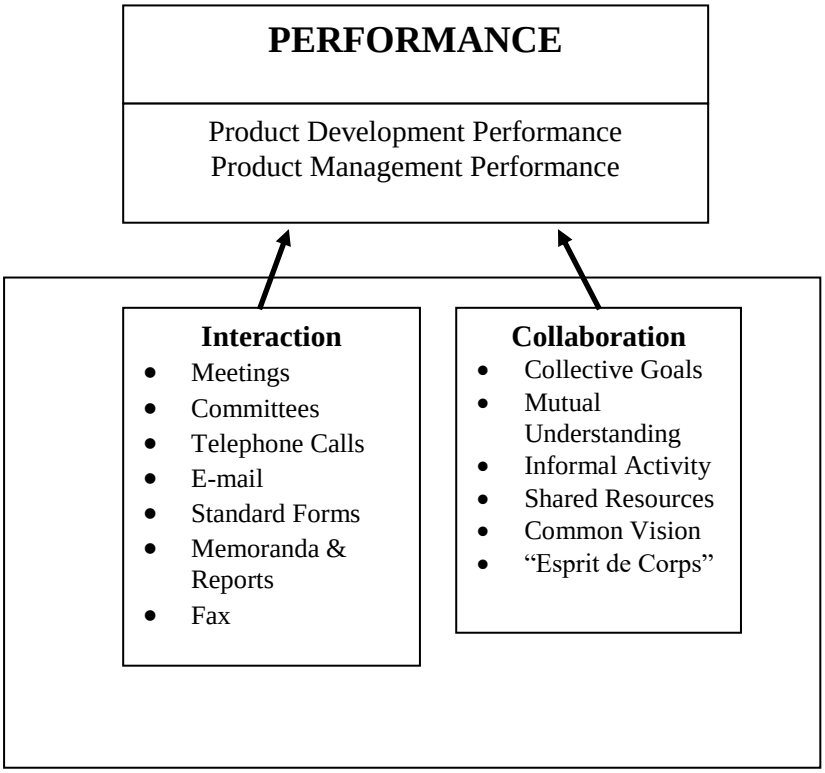


Figure 3.6: A model of interdepartmental Integration

Source: Kahn (1996, p. 141).

O'Leary-Kelly & Flores (2002, p. 226) write that *"…the level of integration refers to the extent to which separate parties work together in a cooperative manner to arrive at mutually acceptable outcomes."* Authors claim that high level of integration can be attained through intense cooperation and interaction.

Ortiz, et al. (1999) enumerates the reasons to secure enterprise wide integration as follows:

- The need to ensure operations run in parallel to strategy.
- Information sharing for a better decision making process.
- Necessity to provide inter-departmental and inter-organizational cooperation.
- Necessity to reply global and highly agile market demands.

Chen, et al. (2007) argue that firm-wide integration can improve company's financial figures such as sales volume, profit margin, and return on assets and also strengthen its competitiveness on market. In addition, scholars assert that operational level conflicts can be easier to solve and concentration can be shifted to a more focused strategic mind set.

3.4. SUSTAINABILITY BALANCED SCORECARD (SBSC): AN EFFECTIVE MEASUREMENT TOOL

Balanced Scorecard is a comprehensive communication framework that sets out coherent performance measures which are organized into four perspectives: financial, customer, internal business process, and learning and growth (Kaplan & Norton, 1996). There is a strongly linked cause and effect chain that is pervaded throughout all four perspectives. Kaplan & Norton (1996) write that these four perspectives are mostly used in many organizations and industries. However, one or more perspectives may be added to commonly employed template depending on business unit's strategy and industrial environment. Figge, et al. (2002) added a new perspective called non-market perspective as shown in figure 3.7. Kaplan & Norton (2004) argue that companies can achieve breakthrough results by employing balanced scorecards plus strategy focused organization and strategy maps which enable companies focus and align their resources to their strategies through a strongly linked cause and effect chain. Kaplan & Norton (2001, p.8) describe five principles of strategy-focused organizations as illustrated in figure 3.8.

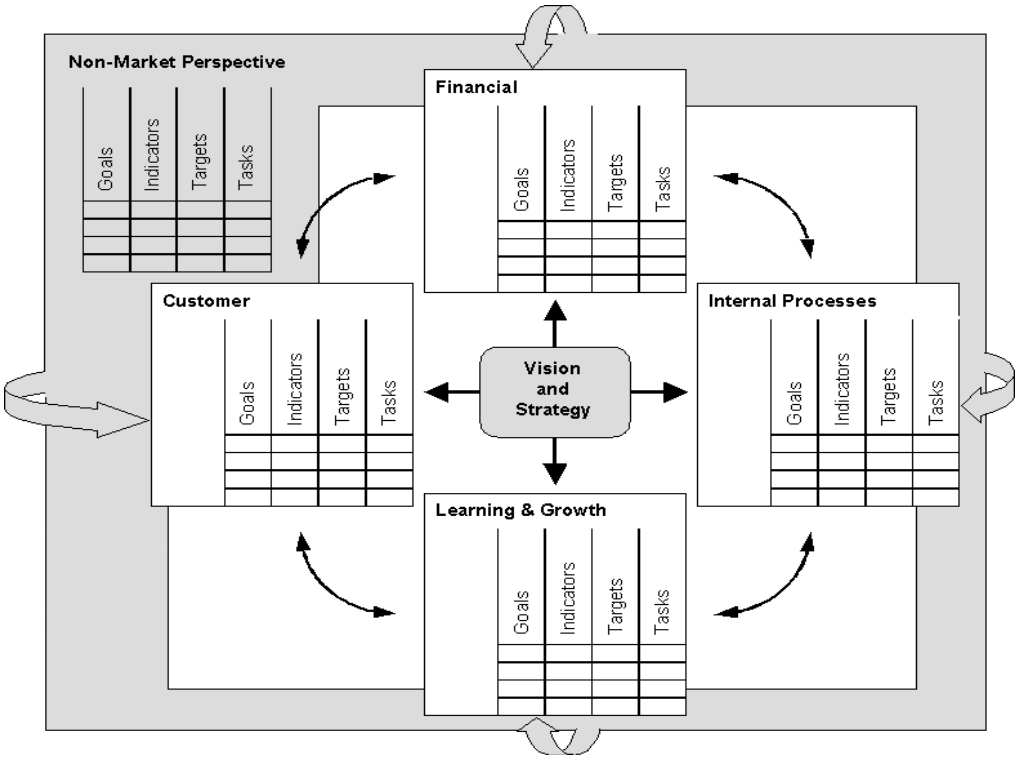


Figure 3.7: Balanced Scorecard enhanced by a non-market perspective

Source: (Figge, et al., 2002 cited in Möller & Schaltegger 2005, p.77).

Figure 3.8: Aligning and Focusing Resources on Strategy

Source: Kaplan & Norton (2001, p. 8)

Sustainability Balanced Scorecard adds the sustainability dimension into traditional framework and strives to improve performance measures in economic, environmental and social aspects simultaneously (Figge, et al., 2002). Wagner (2007) proposes sustainability balanced scorecard as an effective tool to integrate environmental management system to a wide variety of different divisions throughout company such as R&D strategy, quality and H&S, corporate strategy (financial and customer perspective), social aspects. In addition to all, Sustainability Balanced Scorecard (SBSC) can be employed to extend the notion of integration to supply chain (Wagner, 2007). British Telecom, Volkwagen, Hamburg Airport and Novarties are examples to case study companies that validate the balanced scorecard as an effective tool to integrate environmental management system to other managerial perspectives (Wagner 2007). Dias-Sardinha & Lucas Reijnders (2005) employ the thematic balanced scorecard format as an effective analysis tool to understand the weaknesses and strengths of the links that exists between the variables of environmental and social performance evaluation of large Portuguese companies. Figge, et al. (2002) suggests SBSC as a powerful tool to incorporate environmental and social aspects into the main management system of a company. Balanced Scorecard is employed as a tool in several studies to integrate environmental management with other managerial perspectives (Epstein & Wisner 2001; Dias-Sardinha, et al., 2003; Dias-Sardinha, et al., 2007; Möller & Schaltegger, 2005).

3.5. DEFINITION AND SCOPE OF GREEN SUPPLY CHAIN MANAGEMENT (GSCM)

GSCM concept is relatively a new study and practice area emerged as a management philosophy to tackle with the increasing environmental concerns (Zhu & Sarkis, 2004; van Hoek, 1999).

Hu & Hsu (2010) definition implies improvement of logistics management activities with adding life cycle stages into GSCM. However, the scope and perspective is relatively narrow with ignoring green manufacturing and green marketing.

Srivastava (2007) has a broader perspective in defining GSCM with integrating environmental mind-set into SCM that encompasses product design, procurement activities, manufacturing, distribution and end of life management of product after useful life cycle.

We will refer to GSCM definition made by Hervani, et al. (2005) with the below equation:

GSCM = Green Purchasing + Green Manufacturing/Materials Management + Green Distribution/ Marketing + Reverse Logistics

Hervani, et al. (2005) argue that GSCM is mainly addresses the environmental impact caused by Supply Chain Management. As a result, each component in SCM is prefixed with the green label in above equation.

In figure 3.9, Hervani, et al. (2005, p.335) denote the GSCM and the components of this holistic management philosophy. Below illustration also encompasses suppliers and customers' involvement in greening process that is indispensable

component of SCM. In addition, writers underline the importance of management of reusable and recyclable materials and components. However, it would be better to add Integrated Environmental Information Management Systems (IEIMS) as a complementary component of GSCM. IEIMSs are important tools in environmental management support and decision making process with increasing efficiency, enabling compliance with regulations and promoting integration with other management systems (Frysinger, 2001; Karatzas, et al., 2001; Caputo, et al., 2002). Carlson, et al. (2001) state that IEIMS can be integrated into Supply Chain Information Management with enabling a more effective and efficient communication network with customers and suppliers to reduce environmental impacts.

Holt & Ghobadian (2009) categorized the drivers for GSCM as legislation, internal drivers, competitive, supply chain, societal and public opinion/societal expectations. Legislation and internal factors indicated as the major drivers for GSCM while public opinion/societal expectations are listed as minor drivers.

Carter & Jennings (2002) claim that as purchasing managers have a socially responsible perspective, it leads to increased supplier performance and improved trust and commitment to suppliers.

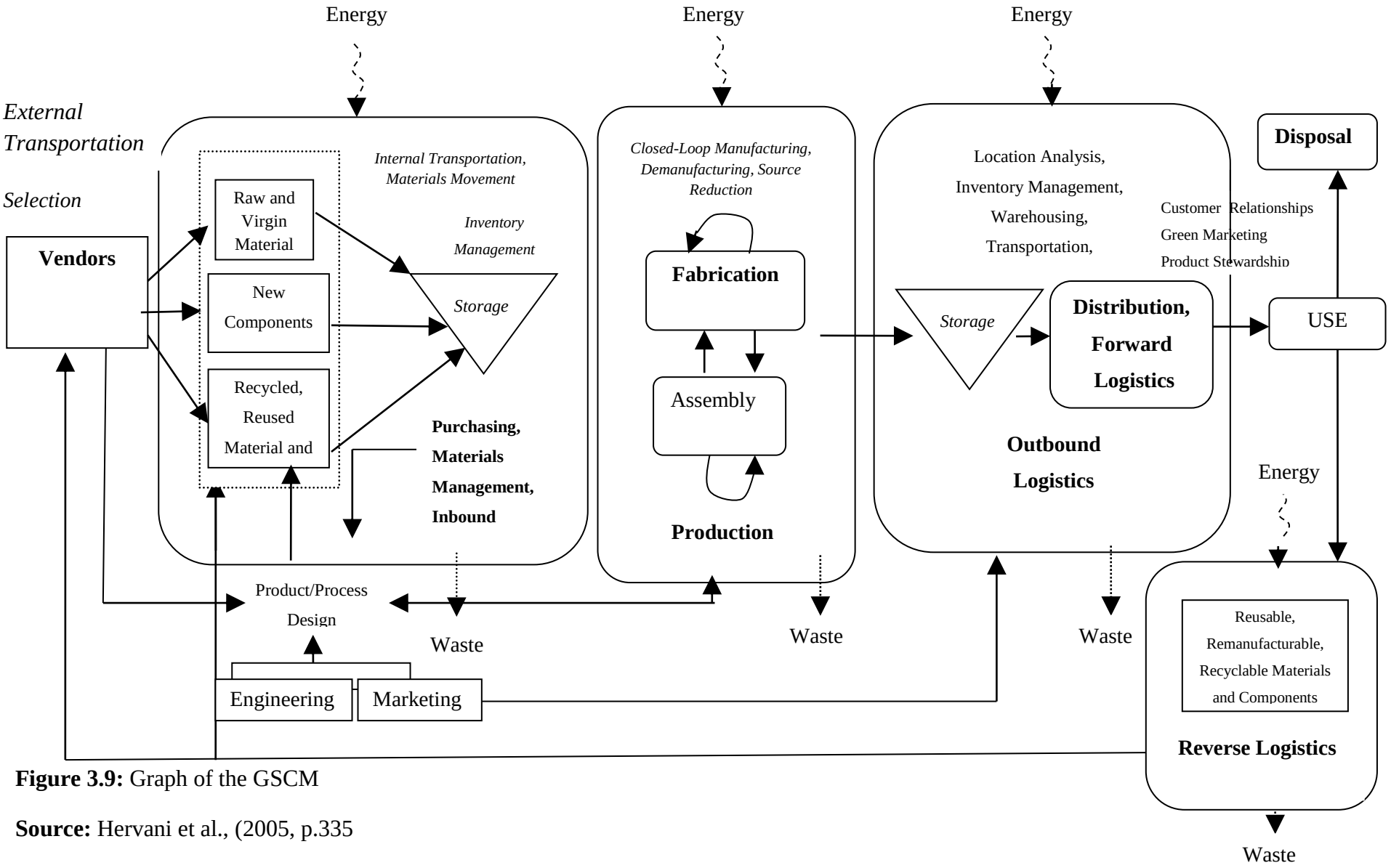


Figure 3.9: Graph of the GSCM

Source: Hervani et al., (2005, p.335

4. OVERVIEW OF SWEDISH STEEL INDUSTRY: AN ENVIRONMENTAL PERSPECTIVE

Sweden is a well known country for producing high quality steel products that mainly stems from abundant natural resources of pure iron ore deposits with low phosphorous content, large forest areas for production of charcoal and rich water resources for production of electricity (Nyquist, 1998).

Since early 1970s, Swedish steel companies have adapted a more decentralized and more flexible organizational structures where responsibilities are disseminated to lower management and diverse geographical locations which contributed to the specialization in niche markets and direct marketing (Nyquist, 1998).

Sweden imports around %80 of domestic steel consumption and exports around %85 of finished steel products which is resulted from Swedish steel industry's policy in producing advanced steel products and importing simpler steel products (Jernkontoret, 2010).

Singh, et al. (2007) writes that production of steel can have various impacts on environment such as acidification, global warming, and depletion of water, land and non-renewable resources. On the other hand; Singh, et al. (2007, p.565) states that *"steel is the most recycled material in the world."*

In figure 4.1, energy use in Swedish steel industry is depicted (Jernkontoret, 2010). Electricity, oil, gas and process coal constitute the major energy group used in Swedish steel industry. The percentage of oil used in Swedish steel industry has decreased dramatically over decades after oil crisis in 1970s (Wang, 2007). On the other hand, the percentage of coal which is a basic input in reduction of iron ore to hot metal in blast furnace increased over years.

Figure 4.2 demonstrates the energy efficiencies gained over years (Jernkontoret, 2010).

Figures 4.3, 4.4 and 4.5 denote the reductions in emissions of nitrogen oxides (NOx), sulphur dioxide (SO_2) and dust from Swedish iron and steel industry respectively (Jernkontoret, 2010). It is mainly achieved by new gas cleaning methodologies, new combustion technologies and filters adapted by companies in their respective processes (Jernkontoret, 2010). In figures 4.3, 4.4 and 4.5, emissions are depicted in terms of yearly emissions, i.e. tonnes of emissions per year and as specific emissions, i.e. tonnes of emissions per tonne of crude steel produced. In three figures, black lines refer to specific emissions and the value for each year is on the right side of y-axis. On the other hand, the bars express yearly emissions and related value is on the left side of y-axis.

One of the basic inputs in steel production is water that is essential in several steps in steel production processes. Therefore, it is imperative to meet water quality standards required by EU directives and standards prepared by Swedish Water Authorities. Swedish steel companies are certified according to ISO 14001 that assures compliance with certain laws and regulations (Jernkontoret, 2010). Moreover, Swedish steel companies has already started to implement modern

water purification technologies in early 1970s and %90 of water used in entire processes recirculated (Jernkontoret, 2010).

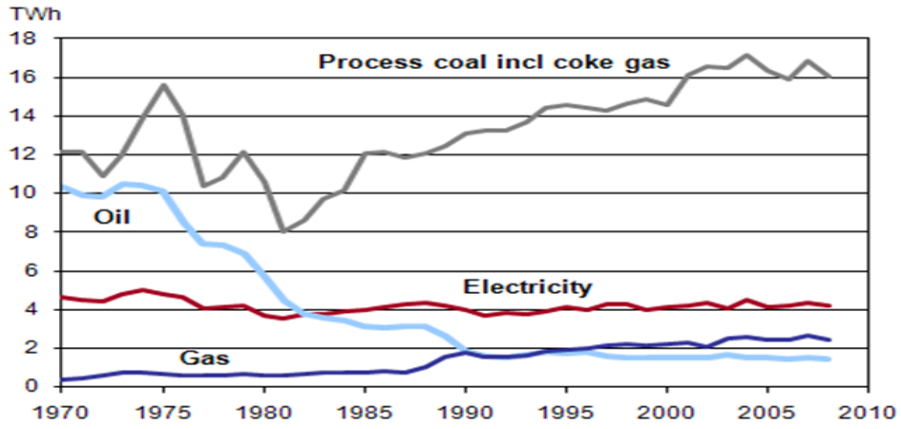


Figure 4.1: Energy use in the Swedish iron and steel industry

Source: Jernkontoret (2010)

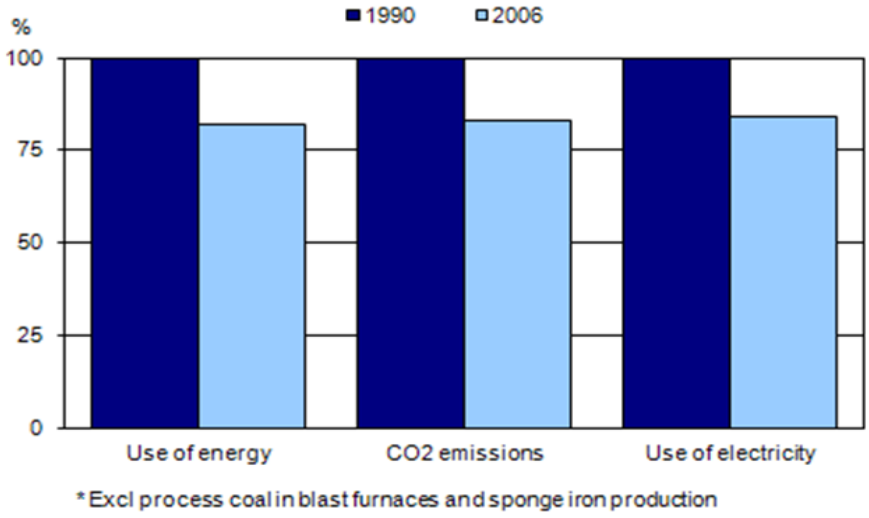


Figure 4.2: Energy Efficiency within the Swedish Steel Industry accounting for development in processes and products

Source: Jernkontoret **(**2010)

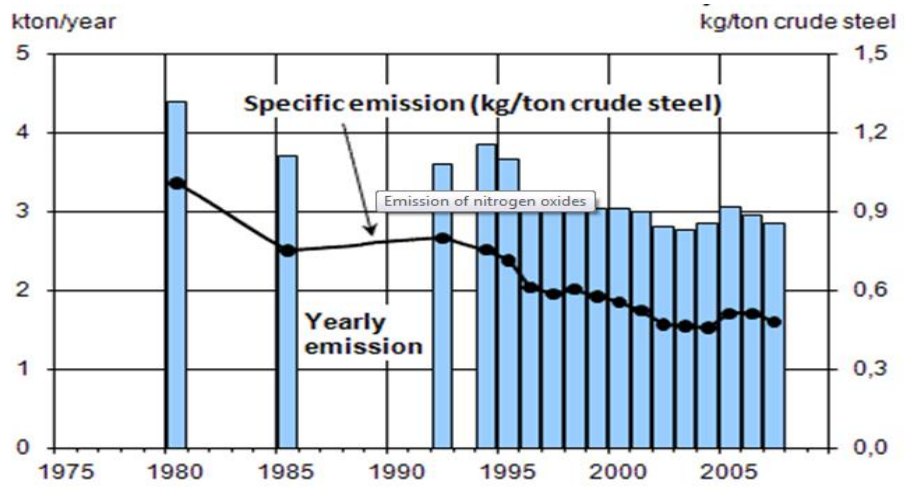


Figure 4.3: Emission of nitrogen oxides (NO_x) from Swedish iron and steel industry

Source: Jernkontoret (2010)

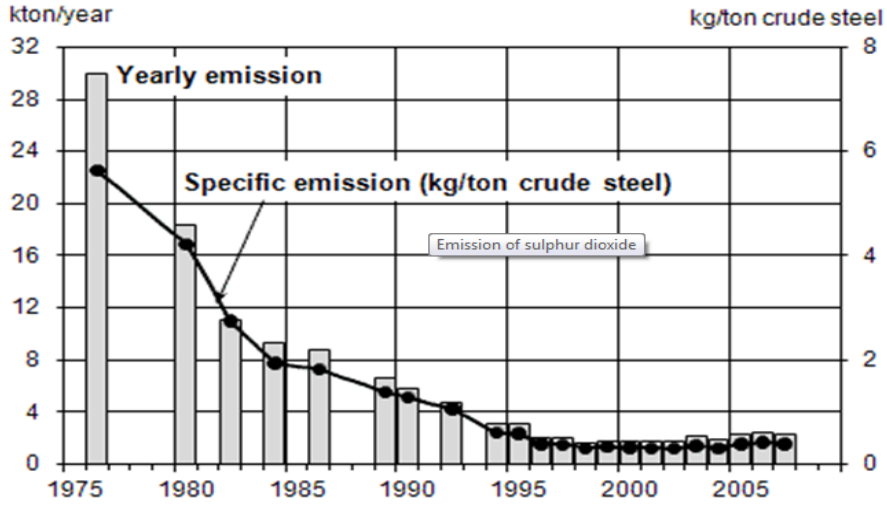


Figure 4.4: Emission of sulphur dioxide (SO_2) from Swedish iron and steel industry

Source: Jernkontoret **(**2010)

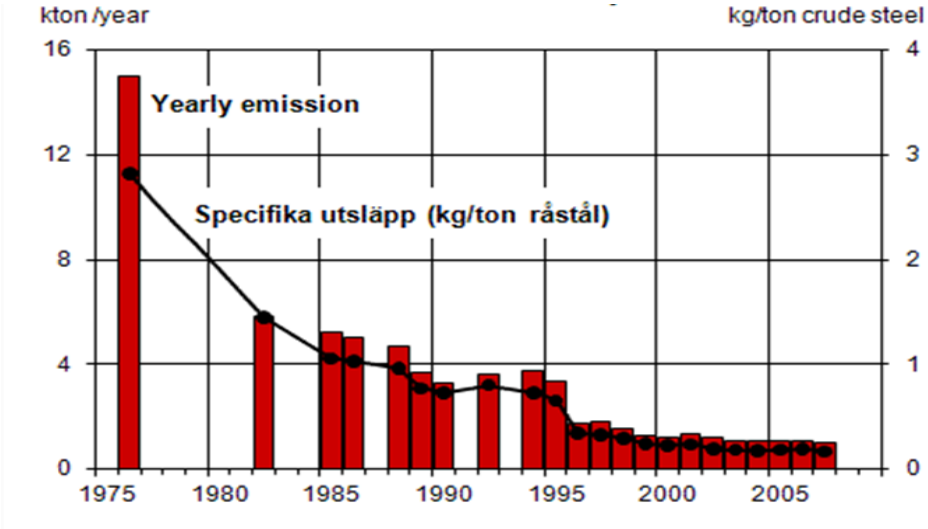


Figure 4.5: Emission of dust from Swedish iron and steel industry

Source: Jernkontoret (2010)

Sandberg, et al. (2001, p.424) state that Swedish steel industry's CO_2 emissions are below world average in figure 4.6. Author compares CO_2 emissions caused by Swedish Steel manufacturers and best practice global steel producers' sites. Blast furnace route and electric arc furnace route are two most commonly preferred processes in steel production with 25% and 100% scrap input respectively (Sandberg, et al., 2001). In figure 4.6, CO_2 emissions are resulted from one ton of steel production depicted in terms of two different process for three product group; hot rolled coil and plate, section and rebar-wire rod-engineering steel. Even CO_2 emissions originated from transportation of steel products added; the averages of Swedish steel producers' CO_2 emissions are lower than global average. Swedish steel industry emits relatively lower CO_2 emissions due to following factors (Sandberg, et al., 2001):

- Developments in steel production processes that lead up to energy efficiencies
- Use of iron ores which contains higher magnetite instead of commonly used hematite ores, as a result 0.15 ton CO_2 reduction provided in pelletizing process per one ton of steel production.
- Electricity is produced mainly by hydro and nuclear powers, thereby CO_2 emissions lowered.
- High strength steel products that provide energy conversation and less CO_2 emissions

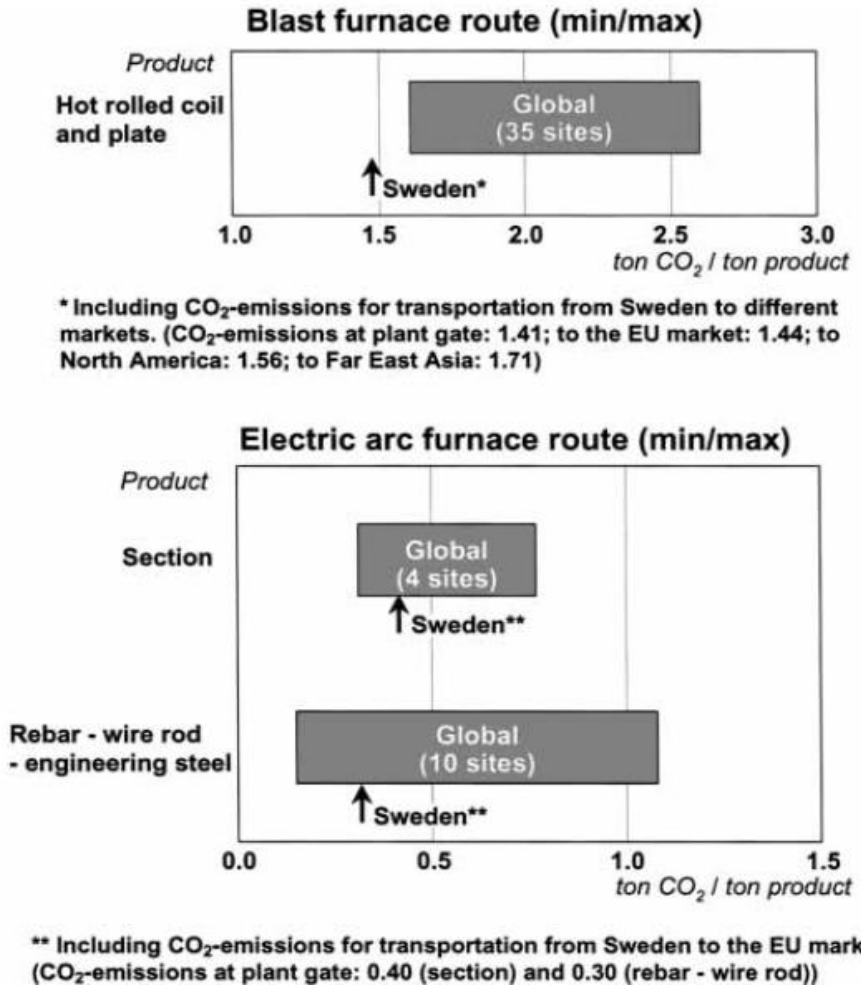


Figure 4.6: CO_2 emissions for Swedish carbon steel products compared to the same products from the best plants in each market.

Source: Sandberg, et al. (2001, p.424)

According to Jernkontoret, every year two million tonnes of residual material generated in Swedish iron and steel industry that is used as follows:

- One third is used externally, e.g. is sold as products
- One third is reused in production processes
- One third is disposed of in landfill

5. CASE COMPANY DESCRIPTION AND FINDINGS

5.1. COMPANY PROFILE

As shown in figure 5.1, Sandvik Tooling is one of the three primary business areas operating under high technology engineering group, Sandvik AB (Sandvik AB, 2010c). Sandvik Tooling is a R&D focused manufacturer of tools and tooling systems that are primarily made of cutting tool materials such as cemented carbide, high speed steel, synthetic diamond, cubic boron nitride and special ceramics to increase productivity in metal cutting; in addition company is specialized in wear parts and superabrasive components (Sandvik AB, 2010c).

Sandvik Tooling comprises independent brands such as Sandvik, Sandvik Coromant, Walter, Safety, Dormer, Diamond Innovations and Wolfram with about 16,400 employees nearly in 70 countries (Sandvik AB, 2010c). In figure 5.2, sales volume and operating margin of Sandvik Tooling is shown in order to give a clear picture of financial strength of company and profitability of core business.

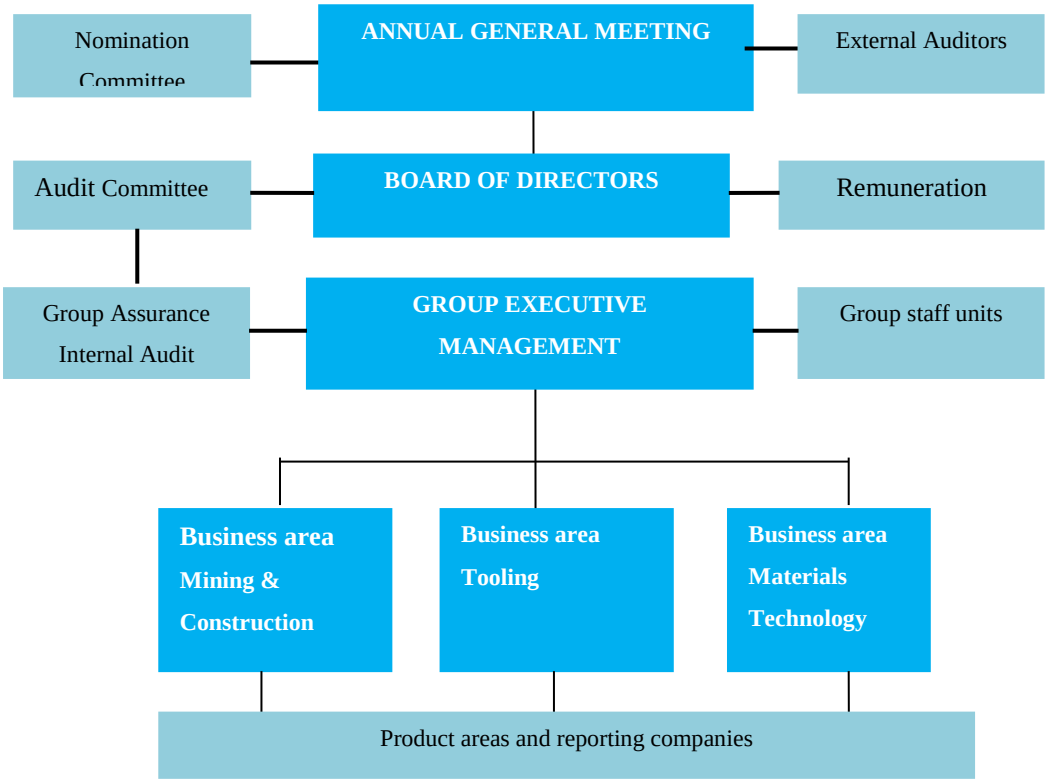


Figure 5.1: Organizational Chart of Sandvik Group

Source: Sandvik AB (2010c, p.100).

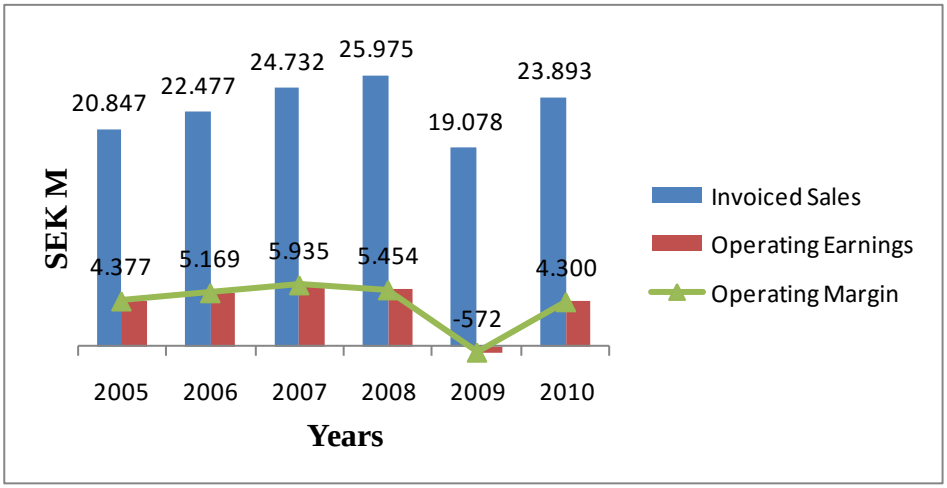


Figure 5.2: Sales, Operating Earnings & Operating Margin of Sandvik Tooling

Source: Sandvik AB (2011b, p.12).

Operating margins are ratios employed to measure operational efficiencies and are important indicators of profitability of core businesses. In figure 5.2, it is shown that profitability is decreased with the recent financial crisis in 2009. However, company increased operational efficiency by 2010 based on previous year.

In figure 5.3 and 5.4, Sandvik Tooling's worldwide customer segments and sales volume by market area are shown respectively. As shown in respective figures, main focus areas are engineering tools and automotive industry and Europe is the biggest market where the majority of orders are handled.

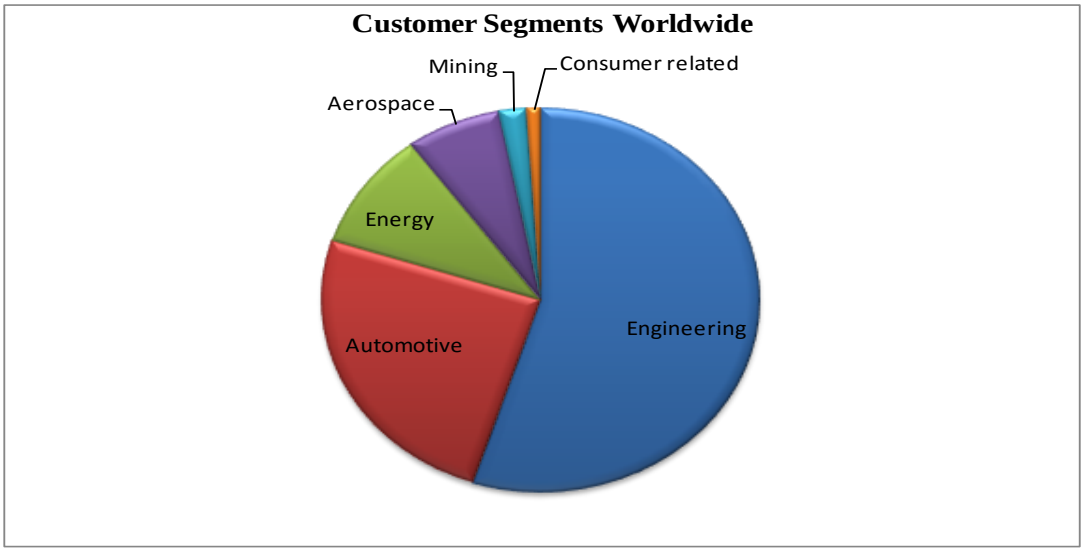


Figure 5.3: Sandvik Tooling Customer Segments Worldwide

Source: Sandvik Tooling (2010, p.4).

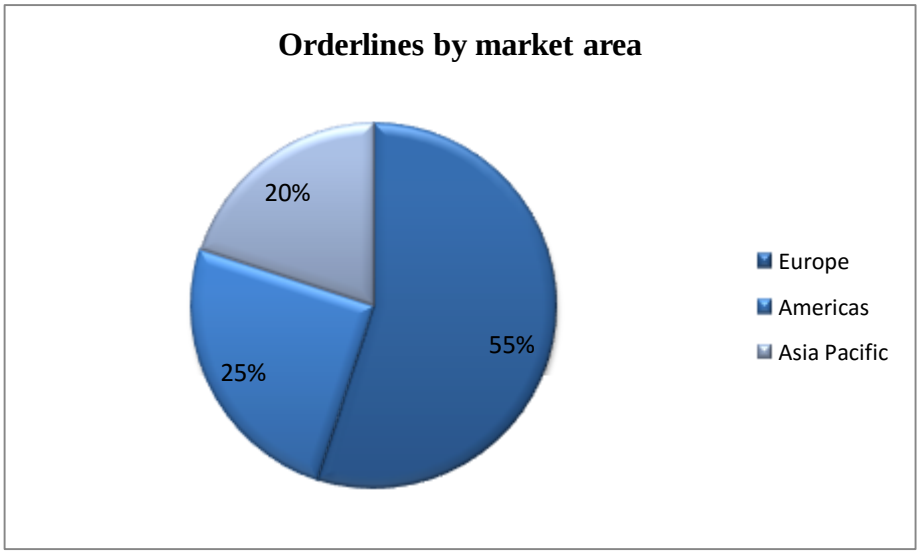


Figure 5.4: Sandvik Tooling's Sales by Market Area

Source: According to e-mail interview with Sörlien, (2010b).

In figure 5.5, matrix organizational structure of Sandvik Tooling is shown. In this matrix structure, Tooling Supply operates as a functional unit in order to provide necessary support for each product area. Later in figure 5.6, Tooling Supply organizational chart is illustrated.

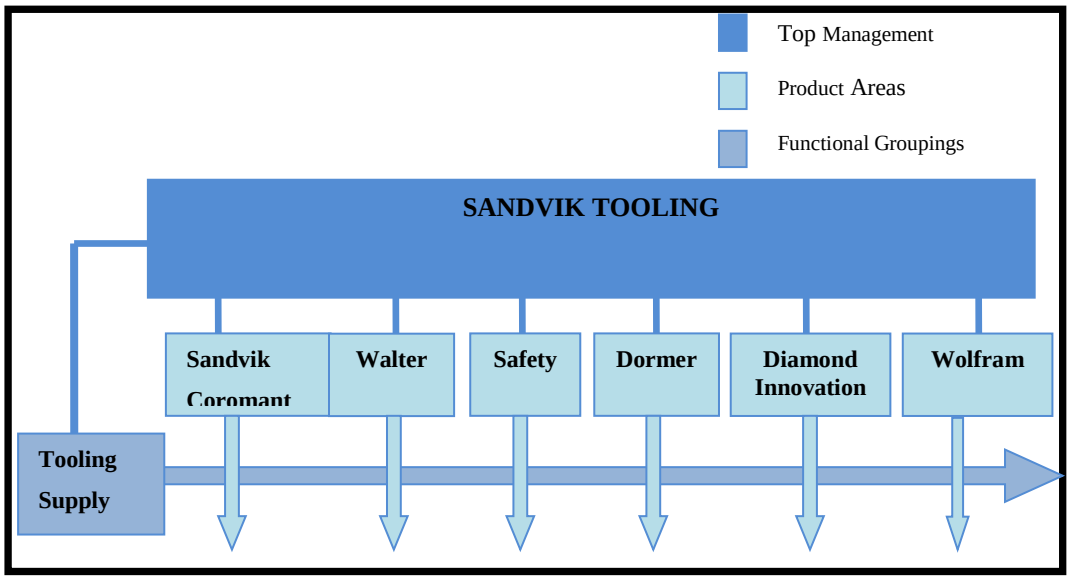


Figure 5.5: Matrix Structure of Sandvik Tooling
Source: According to Interview with Karlsson, (2010).

4.2. SUPPLY CHAIN MANAGEMENT PHILOSOPHY OF SANDVIK TOOLING

Abrahamsson (1993) gives a brief history of how company's supply chain activities evolved from decentralized distribution structure to a centralized one. Before changing the strategy to centralized distribution structure in 1982, company had at least one warehouse for each sales unit. Sales units were located in almost every country, in some cases more than one in each country. Abrahamsson (1993) states that product assortment in each sales unit's warehouse varied between 4000 and 6000 items and lead time from local warehouses for stocked items was 10-30 days while for out of stock items it ranged between 2-3 weeks. After centralization, company started direct deliveries to customers from two distribution centers that are located in Sweden and Netherlands (Abrahamsson, 1993). Distribution Centers' product assortment contained 18.000 items and 3-4,000 orders were handled daily (Abrahamsson, 1993). Author concludes that after centralization of warehouses, inventory costs decreased tremendously and lead time reduced to one day within Europe with increased delivery performance.

Acquisition of Wolfram in 2009, a major supplier, facilitated control over the entire supply chain from ore to finished products (Sandvik AB, 2010c, p.9). Sandvik Tooling pursues logistics postponement strategy with three strategically located distribution centers; in Schiedam (Netherlands), Kentucky (US) and Singapore (Sörlien, 2010a). In figure 5.6, the evolution from traditional supply chain processes to the current supply chain strategy pursued by Sandvik Tooling is illustrated. Company follow direct sales & marketing strategy via decentralized sales units located all around the world. On the other side, manufacturing processes are finalized before the customer order taken on the basis of forecast driven anticipated market demand. Once a customer order is received by sales units, deliveries are provided worldwide mostly within 24 hours via air transportation by three strategically located distribution centers (Sörlien, 2010a). Product assortments contains around 100.000 items in each DC that are carefully planned, optimized and managed to meet customer demands and about 11 million orders are handled per year (Sörlien, 2010b). In figure 5.7, Sandvik Tooling's Supply Chain activities are depicted. Sandvik Tooling retains and utilizes the advantages of economies of scale and offers a broad range of product assortment while reduces unnecessary inventory costs and provides fast deliveries all around the world (Sörlien, 2010a).

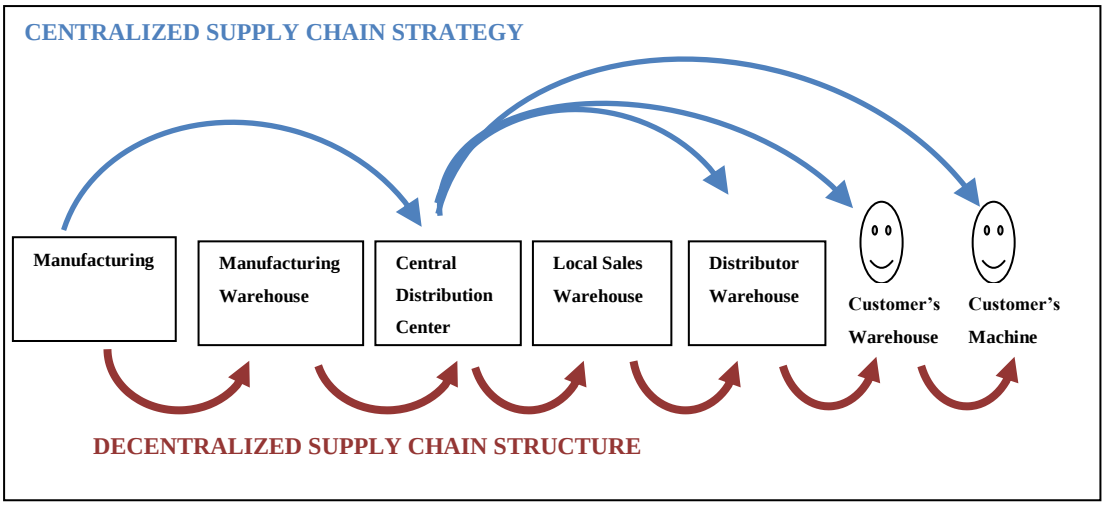


Figure 5.6: Evolution of Supply Chain Processes within Sandvik Tooling

Source: Kommerskollegium, (2010).

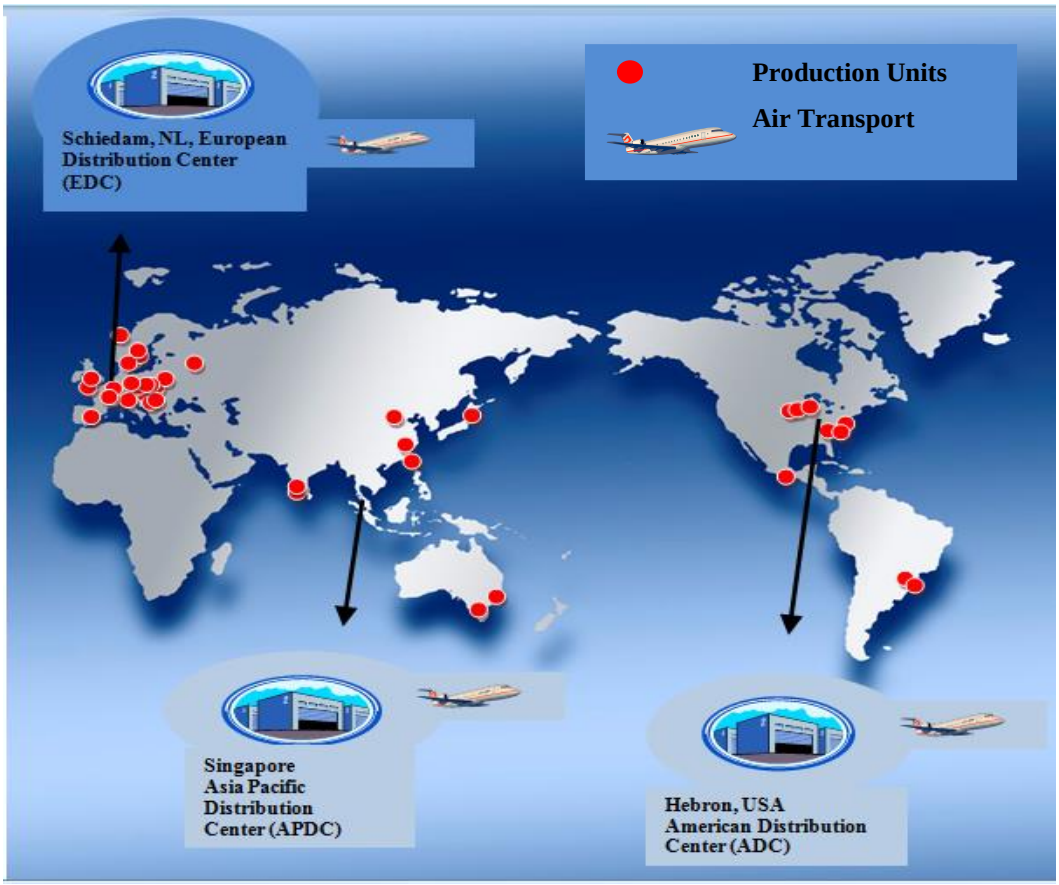


Figure 5.7: Supply Chain Management within Sandvik Tooling

Source: According to interview conducted with Sörlien, (2010a).

5.3. ENVIRONMENTAL MANAGEMENT SYSTEM IMPLEMENTATION WITHIN SANDVIK TOOLING

Fair play is one of the three core values declared by Sandvik Group which is defined as managing resources in a sustainable manner (Sandvik AB, 2010). Environmental and social goals are considered to be equally important pillars alongside financial goals which finally paved the way for the fair play concept in 2002 by declaration of Sandvik's President Lars Pettersson (Berglund, 2010). The person who is in charge of non financial assurance and implementation of Fair Play in organization, Berglund (2010) tells that *"…during the 1990s, there was no management system in place, no policies and no improvement targets. In 1999, we adopted our first certified environmental management system."* Today, company is included in Dow Jones Sustainability World Index, FTSE4Good Index and Ethibel Excellence Investment Register with ranking among the world's top 10% most sustainable corporations (Sandvik AB, 2010).

Customers' demands for EMS certificate and company's solicitude for environmental issues brought about the efforts for the first ISO 14001 accredited certification in 1999 (Karlsson, 2010). Today, Sandvik Tooling's all "major production units"* worldwide and DCs are certified according to ISO 14001 standards by Det Norske Veritas (see Appendix B). DNV verifies conformity of all sites with ISO 14001 standards and the scope of activities include *"Design, development, manufacturing, recycling, sales and distribution of tools, inserts and tooling systems for metal cutting, as well as carbide powder, wear parts and superabrasive components"* (see Appendix B).

Environmental Policy

Sandvik Group environmental policy emphasizes the aspirations of company to achieve continual improvement of environmental performances, ensure compliance with applicable laws and sustain development which binds all business areas (Sandvik AB, 2010).

Planning

Sandvik Tooling complies with and exceeds all applicable *legal and other requirements*. Company believes that environmental requirements and standards should be planned at an international level and implemented effectively on common grounds (Sandvik AB, 2010).

The most common *environmental aspects* within Sandvik Tooling are indicated as energy/electricity use, waste disposal (including coolants, mineral oil, sludge, trash that cannot be recycled), emissions to air (including CO_2, CO, cobalt, hard metal powder, toxic gases from production and business travel), emissions to water and water consumption (Sandvik AB, 2010a). Environmental aspects of Sandvik AB are shown respectively in tables 5.1, 5.2, 5.3, 5.4, 5.5, 5.6 and 5.7. According to tables; there is an increase in water consumption, energy use, carbon dioxide emissions, emissions to water and air, produced waste and emissions of process water. Company relates results with acquisitions and increase in production. In figures 5.8 and 5.9, it is depicted that there is no improvement in

carbon dioxide emissions and energy use in relation to sales volume from 2008 to 2010.

Water Consumption	2010	2009	2008	2007
Water Consumption (thousands m^3)	8,900	7,100	6,600	6,800
of which purchased fresh water (thousands m^3)	3,400	3,200	3,600	3,500
of which groundwater (thousands m^3)	600	600	500	500
of which harvested surface water (thousands m^3)	4,900	3,300	2,500	2,800

Table 5.1: Water Consumption by Sandvik AB
Source: Sandvik AB (2011a, p. 104).

Energy use	2010	2009	2008	2007
Use of energy (TJ)	9,100	7,500	8,900	8,800
of which fossil fuels (TJ) direct energy	3,900	2,900	3,400	3,400
of which electricity (TJ) indirect energy*	5,200	4,600	5,500	5,400

*Use of energy does not include the energy used by electricity producers to generate the electricity.

Table 5.2: Energy Use within Sandvik AB
Source: Sandvik AB (2011a, p. 104).

Carbon dioxide emissions	2010	2009	2008	2007
Carbon dioxide emissions (thousand metric tons CO_2)*	559	479	566	547
of which from combustion of fossil fuels (thousand metric tons CO_2). Direct	260	195	224	226
of which from use of electrical energy (thousand metric tons CO_2). Indirect**	299	284	342	321

*Excluding emissions from the transport of raw materials and finished products as well as travel.
**Emissions are calculated using factors from electricity suppliers or the International Energy Agency Data Services. Emissions also include emissions from electricity generation.

Table 5.3: Carbon dioxide emissions caused by Sandvik AB
Source: Sandvik AB (2011a, p. 105).

Carbon dioxide emissions from passenger transports*	2010	2009	2008	2007
Emissions from passenger transports via air travel (thousand metric tons CO_2)	33	22	/	/
Emissions from passenger transports via hire car (thousand metric tons CO_2)	8	6	/	/

*Emissions based on collected data from Sandvik employees corresponding to 68% (72) of the Group's workforce

Table 5.4: Carbon dioxide emissions from passenger transports in Sandvik AB
Source: Sandvik AB (2011a, p. 105).

Emissions to water	2010	2009	Emissions to air	2010	2009
Nitrogen to water (kg)	379,000	201,000	VOC to air (kg)*	62,000	65,000
Phosphorous to water (kg)	1,300	1,400	SO_2 to air (kg)	69,000	45,000
COD to water (kg)	201,000	172,000	NO_x to air (kg)	441,000	379,000
Nickel to water (kg)	180	680			
Chromium to water (kg)	60	70			

*Only from combustion of fossil fuels.

Table 5.5: Emissions to water and air in Sandvik AB
Source: Sandvik AB (2011a, p. 105; 2010, p.95).

Emissions of process water	2010	2009	2008	2007
Volume of process water discharged (thousands m^3)	2,200	1,400	/	/

Table 5.6: Emissions of process water in Sandvik AB
Source: Sandvik AB (2011a, p. 105).

Produced waste	2010	2009	2008	2007
Waste (thousand metric tons)*	417	280	166	171
of which, hazardous waste (thousand metric tons)	34	27	32	28
of which, to landfill (thousand metric tons)	358	231	109	105

*Excluding scrap metal that has been internally or externally recycled.

Table 5.7: Produced waste by Sandvik AB
Source: Sandvik AB (2011a, p. 106).

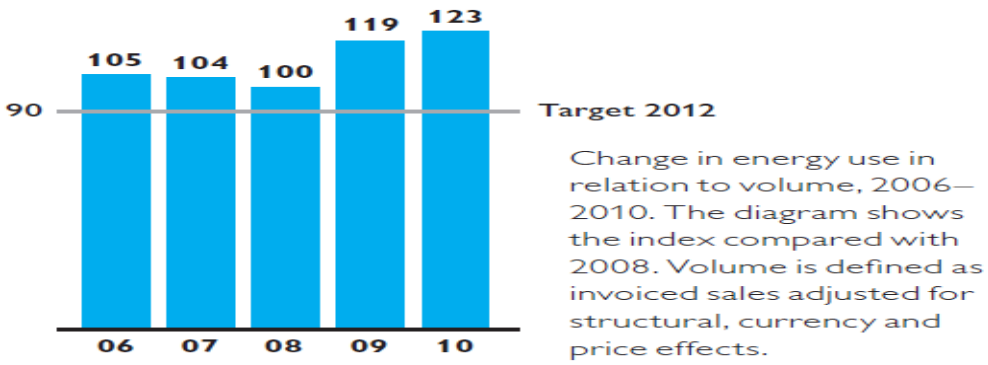


Figure 5.8: Energy use in relation to sales volume

Source: Sandvik AB (2011a, p. 103).

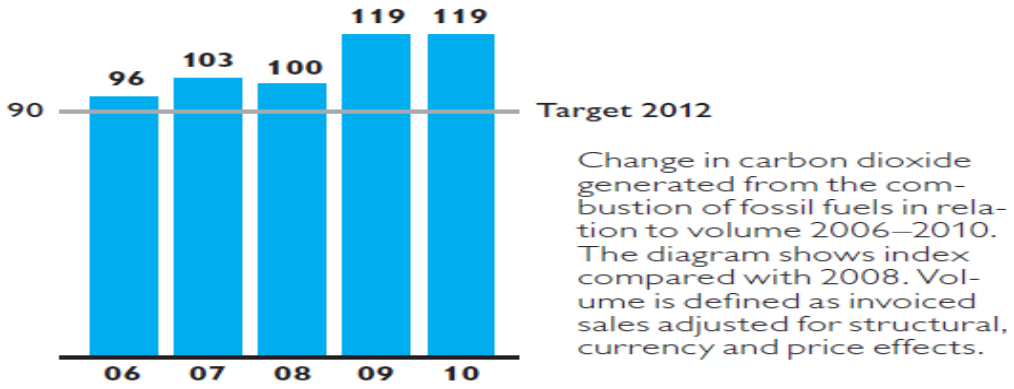


Figure 5.9: Carbon dioxide emissions in relation to sales volume

Source: Sandvik AB (2011a, p. 104).

Environmental objectives were identified in May 2006 after many years of work (Sandvik AB, 2007):

- More efficient use of energy and raw materials.
- Reduced emissions to air and water.
- Increased materials recovery, both internally within Sandvik and externally by recovery of the Group's products.
- Increased materials recovery, both internally within Sandvik and externally by recovery of the Group's products.
- Reduced environmental impact from the use of hazardous chemicals.

Environmental targets are aimed to (Sandvik AB, 2010b):

- Reduce energy and water consumption and CO_2 emissions in relation to sales volume by 10% before year end 2012 (base year 2008). By year-end 2010 the reduction shall be 5% relative to the base year.
- Conduct energy survey in all major production units and DCs before year end 2010 unless this has already been done at least once since 2006.
- All major production units and DCs shall be certified in accordance with ISO 14001 within two years after acquisition/establishment.
- Replace all chlorinated solvents such as dichloromethane, tetrachloroethene, tetra chloromethane, trichloroethane and trichloroethene, with other solvents or techniques before year-end 2010.
- Sandvik Tooling will define what *"support sustainability principles"* means with regard to its products and identify those products that currently meet this definition before year-end 2010.

Implementation and Operation

Resources, roles, responsibility and authority

In figure 5.10, organizational chart of Tooling Supply depicted in order to give a clear picture of chain of command and span of control. Quality and Environment, Health & Safety (EHS) systems are integrated into one system and responsible for relevant issues throughout the entire Supply Chain from purchasing to production

and delivery to customers. Business areas are responsible to ensure proper implementation of environmental management systems while policies, objectives, targets, strategies and performance indicators established at Group level as shown in figure 5.11 (Sandvik AB 2011a, p.97). Karlsson (2010) specified that decentralization is expanded further to each brand and production unit because in each unit, macro and micro environmental concerns may change. However, decisions taken on unit level must always be compatible with Tooling and Group level manuals.

Figure 5.10: Organizational Chart of Tooling Supply

Source: Birgitta Karlsson, (2010).

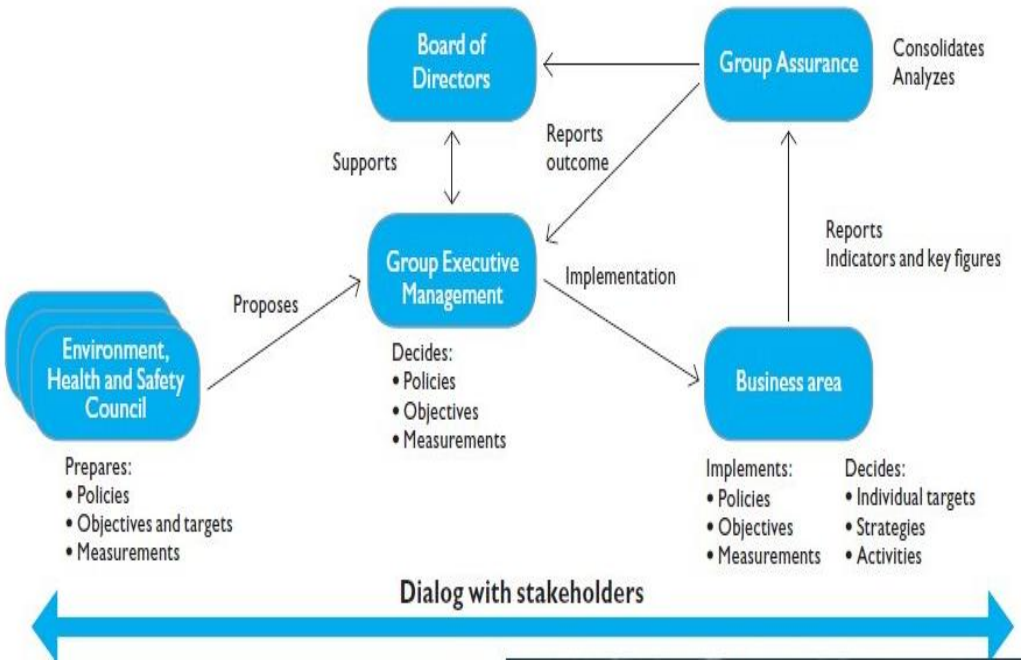


Figure 5.11: Management Process for Sustainable Development

Source: Sandvik AB (2011a, p.97).

Competence, training and awareness

All employees within Sandvik Tooling receive 4 hours basic training on environmental issues and two booklets are given to each employee after successfully completing training programme (Karlsson, 2010). Further trainings are provided depending on positions and roles of employees within company and associated risks. In figure 5.12, days spent competence development per employee and market area is depicted. One of the main themes at trainings was about Sandvik's sustainability work and code of conduct (Sandvik 2011a, p.100).

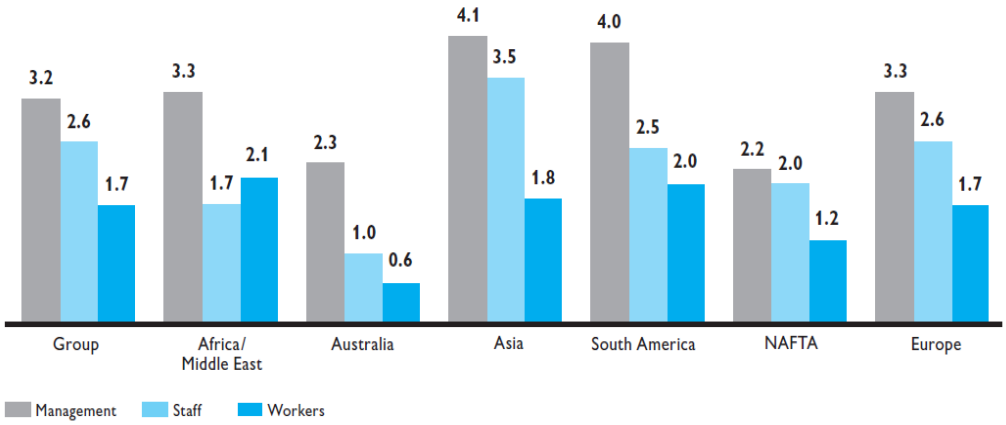


Figure 5.12: Competence development, days per employee and market area

Source: Sandvik AB (2011a, p.100).

Communication and Documentation

Company communicates EMS and all associated issues internally via intranet which is available for all workers (Karlsson, 2010). Company meetings, newsletters, brochures, booklets, etc. constitute other ways of internal communication. Company responds, requires and documents relevant environmental issues in various ways which are communicated externally. Company issues sustainability report every year which covers environmental policy, targets, objectives, and other relevant environmental topics in order to inform stakeholders. Sustainability report is prepared according to sustainability reporting guidelines published by Global Reporting Initiative (GRI) and verified externally by a third party (Sandvik AB, 2010). Company gives further information about the projects completed to achieve environmental objectives in The Sandvik World publication (Sandvik AB 2009; 2010d; 2011b). Moreover, company issues a corporate magazine called Meet Sandvik, three times a year in which environmental issues are addressed as well. Besides, company arranges meeting with investors, analysts and journalists on capital market days. All of the documents are available in company's official website under investor relations and news and media tabs.

Control of Documents and Operations

Organization measure identified environmental aspects in each production unit every month (Karlsson, 2010). Then all the environmental key performance

indicators (KPIs) are saved in documented form and kept as records. All these records are controlled by environmental managers and if required preventive and corrective actions are taken.

Emergency Preparedness and Response

The Sandvik Group adopted Enterprise Risk Management (ERM) program in order to identify, measure, manage, report, monitor and control all risks associated with all parts of operations, business areas and Group functions (Sandvik AB, 2010). After identifying risks, an action plan is carried out for eliminating or minimizing all associated risks. As a part of that holistic risk management philosophy, emergency preparedness and response is planned and developed. Each manager who has the responsibility of associated operations summarizes the risks in a report with detailed action plans. Managers have to pay a great deal of attention to details before they submit the reports.

Checking

Monitoring and Measurement

Each production unit monitors and measures environmental aspects on monthly basis that can have significant impacts on environment (Karlsson, 2010). Measurement and monitoring equipments are calibrated according to standards which are applicable internationally. Each unit issue a report regularly which is assessed and reviewed by environmental and top managers.

Evaluation of Compliance

Sandvik Tooling operates in different countries and markets that are distributed in wide range geography. Therefore responsibilities are distributed to lower levels in order to identify, control and manage the risks. Each manager who has the operational responsibility shall ensure that associated risks are adequately overcome and reported regularly to higher managers for further evaluation (Sandvik, 2010). Company also internally set up regulatory frameworks and instructions in order to support managers.

Nonconformity, corrective action and preventive action

Each manager with operational responsibility identifies measures and manages environmental risks (Sandvik, 2010). Proactive risk management philosophy enables company to identify risks before it occurs and take preventive and/or corrective actions. If there are nonconformities, immediate action plans are executed. Internal and external audits play major roles in determining nonconformities and proposing a course of action as well.

Control of Records

Company keeps records of all facts that prove compliance with ISO 14001 standard. Records are documented and also saved in intranet for regular assessments and reviews (Karlsson, 2010).

Internal and External Audits

Company conducts internal and external audits every year (Karlsson, 2010). Each year different focus areas are determined and audited globally (Karlsson, 2010).

Management Review

Executive Group Management reviews a consolidated ERM report twice a year while the same report is reviewed by Board of Directors once a year (Sandvik, 2010). Company also publishes sustainability report and audit report every year which is reviewed by environmental managers and top executives. Following the assessments done according to reviews, further improvement and changes might be done in the process of EMS implementation.

4.4. EMS INTEGRATION TO SCM WITHIN SANDVIK TOOLING

Integration process comprises suppliers, manufacturing, design & development, sales, DCs, customers and recycling process.

Sadnvik Tooling communicates, publishes and shares environmental management system related works under Environmental, Health and Safety (EHS) section that takes place in intranet of the company (Karlsson, 2010). Company employees and managers share information, experiences, and knowledge and discuss environmental issues through EHS discussion forum that takes place under the same tab. This virtual platform increases competence through global information sharing and support material as well. Supportive materials such as booklets, brochures and other training materials conceptualize environmental works and increases internal commitment and motivation (Karlsson, 2010). In addition, top management commitment and statements about their support and strong motivation towards environmental objectives also play a pivotal role. Department managers, presentations, trainings and competence programmes within company, interrelations with colleagues increase environmental competency as well. Company also collaborates with universities in various locations (Sandvik International Mining & Construction School, 2007; Cummings & Roodzant, 2009; Högskolan i Gävle, 2009).

Sandvik Tooling ensures that all suppliers comply with Code of Conduct which encompasses environmental concerns and other components of fair play concept (Sandvik AB, 2010). Sandvik Tooling set forth minimum standards to be an approved supplier and qualifying standards which is not obligatory to become a supplier but an important assessment criterion (Sirianni, 2010). Standards categorized in labor, environment and business ethics. Environmental standards will take place in this study as it’s the main concern of this study.

Minimum standard for environment requires all suppliers to have an environmental policy statement.

Qualifying Standards for environment listed below (Sirianni, 2010):

1. *Chemical and Hazardous Materials*

   Chemical and other materials posing a hazard if released into the environment are to be identified and managed to ensure their safe handling , movement, storage, recycling or reuse and disposal.

2. *Minimize waste, Maximize Recycling*

   Waste water and solid waste generated from operations, industrial processes and sanitation facilities is to be monitored, controlled and treated as required prior to discharge or disposal. Other types of wastes are to be reduced or eliminated at source or through such practices as modifying production, maintenance and facility processes, materials substitution, conservation, recycling and reusing materials.

3. *Air Emissions:*

   Air emissions of volatile organic chemicals, aerosols, corrosives, particulates, ozone-depleting chemicals and combustion of by-products generated from operations are to be characterized, monitored, controlled and treated as required prior to discharge.

4. *Greenhouse Gas Emissions:*

   The supplier shall strive to reduce greenhouse gas emissions caused by its business operations, primarily carbon dioxide (CO_2) emissions. The monitoring and documentation of CO_2 emissions associated with Sandvik's share of production will be encouraged. Information about CO_2 management shall be provided to Sandvik on request.

5. *Energy Management:*

   Energy management with focus on minimizing the waste of energy shall be applied all suppliers' business operations.

In addition to above standards, company categorizes suppliers into risk groups. Company conducts audits in high risk groups which are also placed under special surveillance (Sandvik AB, 2010). Company also provides training programmes for the selected companies to increase environmental performance and awareness (Sandvik AB, 2010). On the other hand, company sends questionnaire to suppliers which are willing to do business with Sandvik Tooling (see Appendix C). If company is not ISO 14001 certified, another questionnaire is sent to evaluate the environmental performance of the company (see Appendix D).

Karlsson (2010) pointed out that there are managers in each production unit and DC who are responsible for ensuring conformity with ISO 14001 standards. Together with all managers in charge of EMS implementation, they form a network where they can share experiences, knowledge and information. Company

organized a conference in 2007 in which 65 Quality and EHS managers from worldwide offices of the organization took part. In this conference, environmental issues are addressed and experiences, information and knowledge on environmental management systems shared (Karlsson, 2010). After this worldwide participation, company arranged meetings and conferences in focus areas. Karlsson (2010) arranges appointments with managers throughout supply chain whenever there is a need for environmental improvements in relevant areas and meetings may be held on regular and irregular time intervals depending on topic.

Sandvik AB (2010) incorporated environmental thinking into research & development processes. Company offers products that can increase customer productivity and reduce resources used in production processes and minimize wastes.

Sandvik Coromant (2011) developed a recycling concept in collaboration with its customers. Company provides customers collection and transportation boxes in which inserts and solid tools are collected. Then these used materials are sent to recycling plants which are certified according to ISO 14001 and broken down to their original raw material states (Sandvik Coromant, 2011).

Sandvik Coromant (2011) gives training and professional development courses to increase customer's productivity through over 20 productivity centers located worldwide. Company extended its environmental works into sales & marketing activities which attracts customers with the promise of productivity and efficiency in product offerings and manufacturing processes (Sandvik AB, 2010). Company has close relations with customers with streamlining their operations and enhancing efficient energy management methods (Sandvik AB, 2010).

6. ANALYSIS AND DISCUSSION

6.1. METHODS EMPLOYED TO INTEGRATE EMS TO SCM

In figure 6.1, the methods employed by Sandvik Tooling to integrate EMS to SCM are depicted. Interaction refers to routine structured information exchange while collaboration requires more intense interrelations in which continuous relationships are essential (Kahn, 1996). Interaction perspective represents external compulsion by EMS directives while collaboration requires a higher vision that goes beyond standards. Sandvik Tooling develops and maintains a collaborative strategy which requires higher commitment and resource allocation throughout supply chain. In interaction perspective, quality and environmental health and safety (EHS) department is perceived as a rival and independent entity in which relations are formal and based on transactional short term interactions. On contrary, according to collaborative perspective EHS is acknowledged as interdependent and cooperative entity in which continuous informal relations are based on common goals with shared vision and resources (Kahn & Mentzer 1996, 1998; Kahn & McDonough III 1997). Collaborative integration comprises joint planning and decision making, working together as a team and a mutual understanding of responsibilities as well (Stank, et al., 1999). Sandvik Tooling employed a composite view of integration in which verbal and documented forms of information exchanged together with novel solutions to provide integration throughout supply chain on the basis of common goals and vision, shared values and resources. Integration is provided with a balanced mixture of interactions and collaborations. Sandvik Tooling schedules interactions which will best fit with company objectives and strategies. So many interactions can impede environmental objectives by overloading managers with too much information, and thus company organizes interactions in the most efficient and effective way to minimize waste and utilize resources. Company enables internal collaboration alongside external collaboration with suppliers, customers, universities, analysts, investors and journalists.

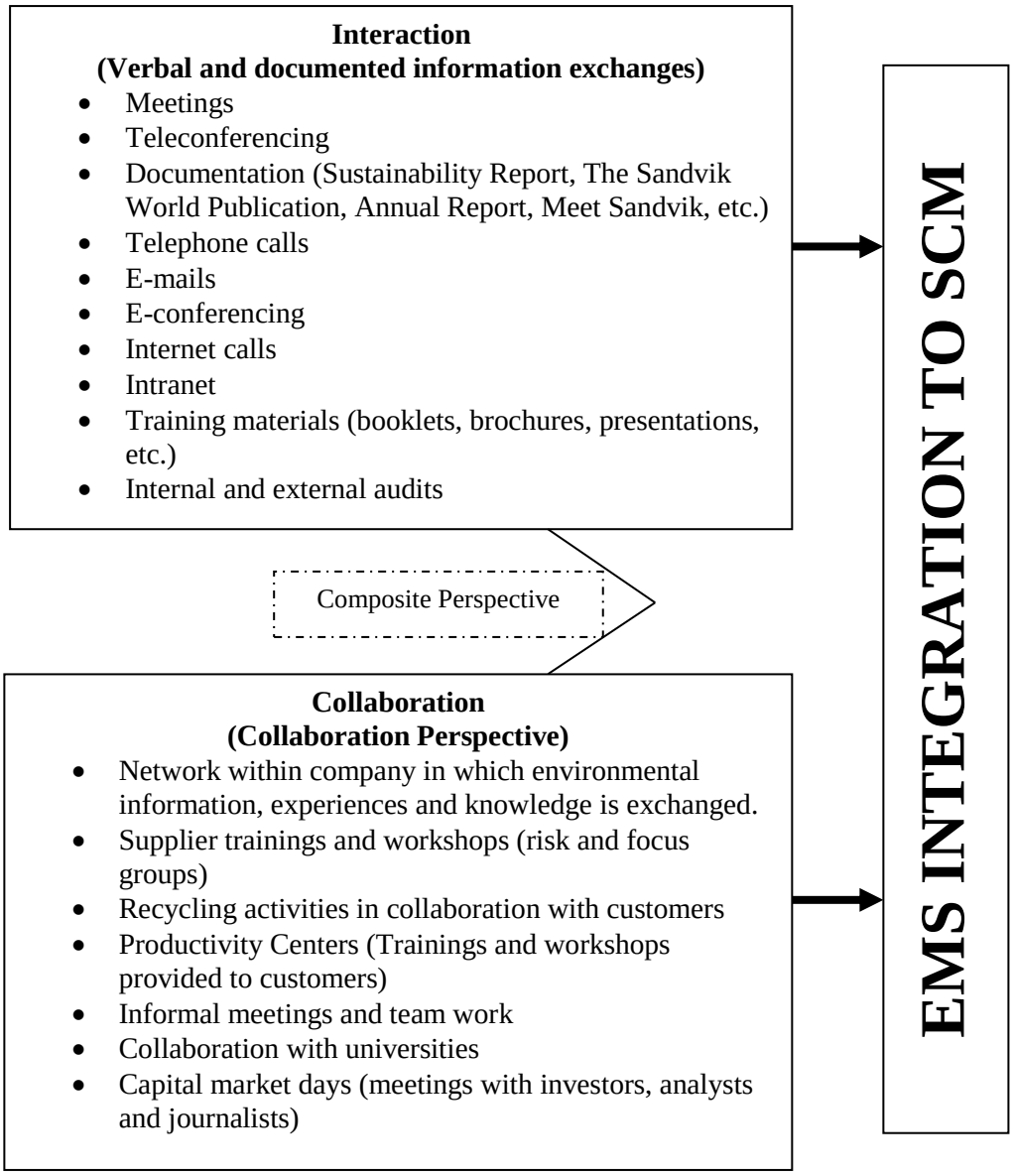


Figure 6.1: Methods employed for integration
Source: Based on Kahn (1996); Kahn & McDonough III (1997); Kahn & Mentzer (1998); Stank, et al. (1999).

6.2. BENEFITS OF INTEGRATING EMS TO SCM

Benefits are categorized as environmental, economic and organizational benefits. These titles under categorization do not reflect independent components, but rather represents highly connected and interrelated factors.

6.2.1 Environmental Benefits

Sandvik Tooling strives to achieve continual improvement of environmental performance through management by objective philosophy. On the basis of this management philosophy, company defines environmental aspects and sets long term environmental objectives by which applicable laws and regulations are met

and exceeded. On the other side, we can draw a conclusion from figures 5.8 and 5.9 that company did not improve energy use and carbon dioxide emissions in relation to sales volume. However, company complies with laws and regulations and even demonstrates a better performance than what is prescribed (Sandvik AB, 2011). Moreover, company takes all preventive and proactive measures with holistic risk assessment philosophy that avoids possible environmental risks and impacts and ensures emergency preparedness and response.

Product designs and development works contribute higher productivities and efficiencies in customer's facilities and as a result better environmental performance (Sandvik AB, 2010; Sandvik AB, 2011). For example, with a cutting edge drilling application can increase tool's life from 50 up to 150 percent and reduce tooling life cycle between 30 and 50 percent (Sandvik Coromant, 2007). In addition to this example, Sandvik's Coromant's advanced tooling technology contributes lighter aircrafts thus yielding lower energy use and reduced carbon dioxide emissions (Sandvik AB 2011, p.24). Moreover, Sandvik Tooling developed tools without cutting fluids that lower production costs and decrease environmental impact. Many other examples is available through company's publications (Sandvik AB, 2008; 2009; 2010d; 2011b).When the productivity of customer increases, it also reflects positively on environmental performance through better utilization of resources such as less energy, oil, water and chemical use.

Sandvik Tooling enhanced measurement tools and methods, and required regular reporting on environmental key performance indicators. As a result, improved control on environmental impact is provided and enhanced benchmarking is achieved.

Company can reduce total energy consumption nearly 75% and cut about 40% of carbon dioxide emissions with the utilization of recycled carbide powder (Sandvik AB, 2009).

6.2.2. Economic Benefits

Companies' strong stance on environmental issues also contributes to a better image and increases the credibility and prestige of company among employees, customers, suppliers, investors, analysts and decision makers (Sandvik AB, 2009).

Environmental policy and strategies bring about economic consequences. In Sandvik Tooling, determining environmental aspects and then developing strategies to systematically lower environmental impacts of that aspects and minimize wastes and potential risks subsequently promote efficiencies that has positive effect on both environment and economy.

Today, majority of customers of Sandvik Tooling are more concerned about environmental issues and initiate the business opportunities with the proviso of being ISO 14001 accredited. Sandvik Tooling does not only provide customers ISO 14001 certificate, but also collaborates with customers to increase their productivity which consequently increase efficiencies within production processes and minimizes waste (Sandvik AB, 2011). Company develops and maintains stronger customer and supplier relations through incorporation of environmental considerations into supply chain philosophy.

Each department in Supply Chain strives to achieve maximum efficiency with minimum waste as a part of company policy. *"Sandvik believes that maximum impact is achieved by preventive programs and by incorporating environmental considerations into product and process development"* (Sandvik AB, 2009). Research & development activities are bedrock of Sandvik Tooling thus yielding improved recycling techniques, art of the state products and methods that increase customer productivity and efficiency. Sandvik Tooling's recycling concept works as an important sustainability tool within supply chain and promotes efficiencies and cost savings. Recycling concept is a bilaterally beneficial process in which customers are paid per kg of collected material and Tungsten, the basic input for production is recycled thus reducing the procurement of raw materials from mines. Sandvik Tooling recycled nearly 60% of tungsten used in cemented carbide products in 2010, excluding Wolfram Bergbau (Sandvik 2011a, p.103). Tungsten carbide is the basic chemical compound used in production processes and there is a huge amount of saving as a result of recycling of this material. More importantly, resources are finite and recycling concept is a big step towards sustainability.

Environmental considerations fit very well in Sandvik's lean philosophy that endeavors to minimize waste and maximize efficiencies. Company develops strategies to minimize costs in distribution centers such as minimizing packaging material, reduce handling and transportation costs and reduce the capital tied up (Sörlien, 2010a; Karlsson, 2010). Centralized Distribution Centers allow company to consolidate shipments and reach greater efficiencies by space utilization.

6.2.3. Organizational Benefits

Worldwide certification enables Sandvik Tooling to sustain a global environmental perspective towards common goals, targets and objectives. Company has a clear vision and mission alongside common values and well defined environmental strategies. After implementation of ISO 14001 in Sandvik Tooling, company has dealt with environmental issues in a more structured way with clearly defined resources, responsibilities and roles. Environmental awareness and competence level increased among employees through training programmes and workshops as shown in figure 5.12.

Sandvik Tooling has an environmental database where each phase of ISO 14001 has taken place and it is accessible by all employees. Company staff can access policies, targets, objectives, reports and all any other topic related to environmental management system. As a result internal communication is enhanced within company. Company documents environmental works and shares internally and externally every year. Consequently, more transparent organizational structuring is achieved and all employees are aware of and participated in environmental management process.

Top management supports and evaluates environmental management system regularly that subsequently fosters involvement and dedication of managers and staff.

Sandvik adopted common guidelines globally that ensured all offices worldwide are on the right track. Otherwise, all local offices have to find their own ways to deal with environmental issues that will cost much more and it will not be such easy to benchmark environmental performances. Company formed a network amongst environmental managers who are responsible for their respective working area. In this network, environmental managers are able to share information, knowledge and experiences that contribute to increase the level of overall competency, lower duplication of resources, save time and lessen mistakes (Karlsson, 2010).

6.3. BARRIERS OF INTEGRATING EMS TO SCM

Sandvik Tooling endeavors to integrate environmental management system to supply chain with utmost effort. However, there are some barriers in front of company while striving to achieve its objectives. In this study, barriers have been mainly categorized as internal and external barriers.

6.3.1. Internal Barriers

Internal barriers are caused by factors that take place within company borders and control.

Training and Competence Development

Company has basic training programmes for all employees and further trainings are given for certain risk groups. However, there is a lack of continuous competence development and training programmes in more advanced level. Company's discussions with trade union organizations revealed that employees perceive EHS, competence development and performance evaluation as key issues (Sandvik AB 2011a, p.100).

Order of Priority

Although company has taken a lot of steps to integrate environmental management philosophy to supply chain, environmental considerations are still behind business priorities as the main objective always has been maintaining profitability. Majority of environmental benefits are not direct result of environmental efforts, but rather a by-product of business philosophy.

Increased Workload

Environmental responsibility and commitment requires more time and more resources. Consideration of environmental aspects besides traditional business concerns such as product and service quality, lead time, cost, etc. increases workload among managers.

5.3.2. External Barriers

External barriers are caused by factors outside the company and take the root from other parties' involvement.

Poor Supplier Commitment

In some countries suppliers may not be committed to environmental work. Sandvik AB encountered some deviations from suppliers' code of conduct particularly in China and India (Sandvik AB 2011a, p. 102). Company strives to integrate green purchasing strategy to its procurement activities. However, sometimes it might not be very easy to substitute senior suppliers if they are very crucial for business. Instead, company defines high risk groups and focus areas. Then company endeavors to change the working culture of suppliers with utmost effort.

Change in Local Environments

Sandvik Tooling applies worldwide certification, and, thus has to deal with local problems in each country. There might be changing regulations and laws in every country. Moreover, organizational cultures and attitudes may differ both in private and public sectors. Sandvik Tooling strives to comply with and even exceed all applicable laws and regulations with the same determination in each country.

Economic Environment

After financial crisis in 2008, company has not arranged meetings and conferences on environmental issues so often or in wide spectrum compared to previous years. Company's policy to decrease overall costs also reflected on environmental works.

Calibration of Measurement Tool and Control System

EMS integration to SCM is still in its infancy, there should be internationally legitimized measurement and monitoring methods throughout the supply chain thus yielding enhanced benchmarking (Sörlien, 2010a).

Lack of Trust among Channel Members

There might be lack of confidence among channel members in some cases. Sandvik Tooling does not share key performance indicators (KPIs) with all channel members, only when a strong trust and commitment is constructed then information is shared (Karlsson, 2010).

Complexity of Supply Chain

Sometimes supply chain is very complex, so it is not easy to control all phases. Maybe your supplier is complying with environmental procedures but your supplier's supplier does not (Karlsson, 2010).

Lack of Control

There is no control on transportation companies' and customers' environmental performance; anyway it is also not an obligation on ISO 14001. As a result, company is not able to measure and monitor all environmental aspects throughout

supply chain. It must be kept in mind that case company is operating in a global environment which subsequently makes it difficult to control and manage supply chain processes.

6.4. SUSTAINABILITY BALANCED SCORECARD (SBSC) AS A STRATEGY MAP FOR SANDVIK TOOLING

In figure 6.2, strategy map of Sandvik Tooling is prepared by writer to provide a visual representation of cause and effect chain among the five perspectives of organization's strategy (Adapted from Kaplan and Norton (2004) & Figge, et al. (2002, p.282). The analysis prepared by writer and the strategic measures give insights to company about how intangible assets lead the way towards long term financial goals.

Between 2000 and 2010, average organic growth rate was 3% and return on capital employed (ROCE) was 23% within Sandvik Tooling (Sandvik AB 2011a, p. 13). Company has long term financial goals to increase the ROCE to 30% and organic growth rate to 7% as illustrated in figure 6.2. Financial performance of Sandvik Tooling is a *lag indicator* that shows the ultimate success of the company. On the other side, financial performance of the company cannot be achieved without other four perspectives illustrated in figure 6.2. Below figure is illustrated from an environmental perspective, considering how environmental management system integration to supply chain can have a positive effect on long term financial goals.

Company's intangible assets are backbones of sustainable value creation and create the suitable environment for competent and focused workforce and align them towards long term strategies. Motivated and competent workforce serve as *lead indicators* for the rest of four perspectives and pave the way for the success of other components. Internal Business Processes comprises the whole supply chain processes through which customer value is created and delivered. Centralized DCs allows a wide range of product assortment with fast delivery times. Hence, customer satisfaction is achieved while costs are lowered through economies of scale.

Environmental management system pervades Sandvik Tooling's supply chain philosophy through global certification and integrated risk management. Supplier perspective is added into generic template to reflect companies endeavor to integrate environmental management system throughout supply chain. Suppliers are perceived as an integral part of environmental works within company and resources are allocated to train and motivate suppliers in line with code of conducts and environmental strategies. Enhanced internal processes and environmental friendly suppliers are lead indicators for subsequent improvements in customer and financial outcomes. Suppliers' integration to environmental management system enhances communication and trust among companies and increase performances.

Company employs a win-win strategy which requires higher integration and trust between companies. Environmental management system serves this strategy through a better image and reputation and increased efficiencies and productivity.

ISO 14001 certification includes design and development of products and improved environmental performance which subsequently increases productivity and efficiency through green products, improved tool performance and better management of environmental aspects.

Production Centers are designed to improve customer productivity through trainings. Recycling concept allows both parties to improve efficiencies. Sandvik Tooling recycles nearly 60% of tungsten that is basic constituent of final products. Customer tailored solutions, customer trainings, enhanced customer productivity increases customer satisfaction together with environmental management system integration and improved environmental performances. Finally, long term financial goals are achieved through this integration process which plays a key role towards sustainability.

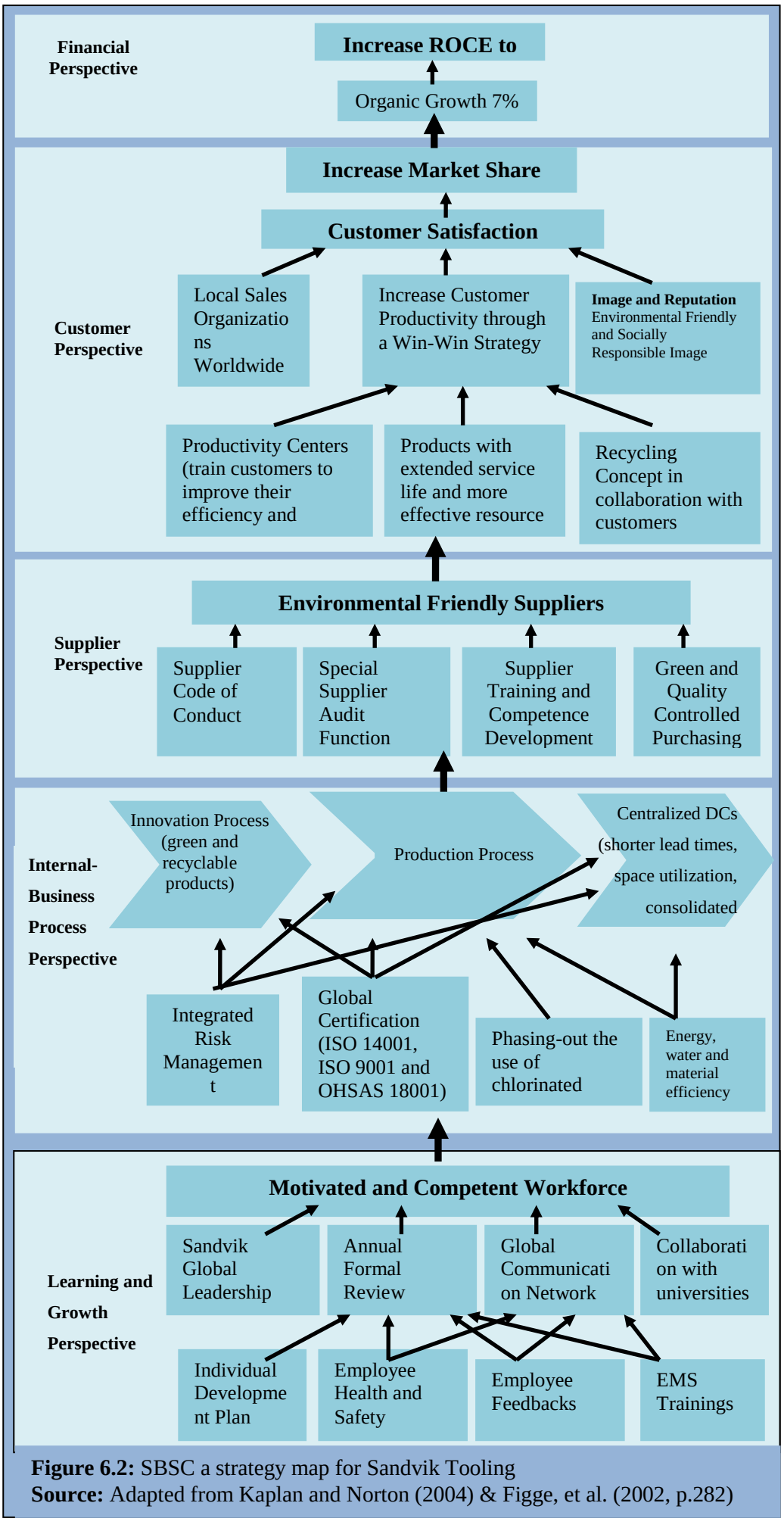


Figure 6.2: SBSC a strategy map for Sandvik Tooling
Source: Adapted from Kaplan and Norton (2004) & Figge, et al. (2002, p.282)

7. CONCLUSIONS

In this study, author aimed to explore the methods employed to integrate EMS to SCM and the type of integration that exists between two systems. After clarifying that, barriers and benefits of integrating EMS to SCM was further investigated.

Triangulation, respondent validation, peer review are the principal strategies employed to ensure validity and reliability of this study (Merriam, 2009).

Author extrapolated following results from the research done according to stated research questions:

1. **How EMS can be integrated into SCM?**

   In figure 6.1, the methods employed two integrate EMS to SCM is depicted. According to interrelations perspective; meetings, teleconferencing, documentation, telephone calls, e-mails, e-conferencing, internet calls, intranet, training materials, internal and external audits constitute verbal and documented forms of information exchanges. On the other side; network within company in which environmental information, experiences and knowledge is exchanged, supplier trainings and workshops (risk and focus groups), recycling activities in collaboration with customers, Productivity Centers (Trainings and workshops provided to customers), informal meetings and team work, collaboration with universities, capital market days (meetings with investors, analysts and journalists) constitute collaborative view of integration.

   Case study Company, Sandvik Tooling employed a composite view in which both perspectives are combined to form a unified integration process. Sandvik Tooling employed a composite view of integration in which verbal and documented forms of information exchanged together with novel solutions to provide integration throughout supply chain on the basis of common goals and vision, shared values and resources. Integration is provided with a balanced mixture of interactions and collaborations.

2. **What are the benefits of integration process?**

   Benefits are categorized as environmental, economic and organizational benefits. These titles under categorization do not reflect independent components, but rather represents highly connected and interrelated factors.

3. **What are the barriers in front of integration process?**

   Barriers have been mainly categorized as internal and external barriers. Internal barriers include training and competence development, order of priority and increased workload. External barriers include, poor supplier commitment, change in local environments, economic environment, calibration of measurement tool and control system, lack of trust among channel members, complexity of supply chain, lack of control.

Author employed Sustainability Balanced Scorecard (SBSC) to analyze the cause and effect relation between separate perspectives throughout supply chain. SBSC was useful to demonstrate how environmental works can finally increase company's financial performance.

In conclusion, this explorative case study represents a good example for other manufacturing companies that are willing to integrate EMS to SCM. Companies can comprehend the cause and effect chain among different perspectives and conceptualize the benefits of integration in an easier and better way. Moreover, the methods employed by Sandvik Tooling to integrate two systems demonstrate a leading path among companies that are willing to develop methodologies or apply in a similar way. Sandvik Tooling has to overcome barriers as well and companies can take into consideration those barriers before commencing integration process.

7.1. GENERALISABILITY OF RESEARCH FINDINGS

"*Case studies are generalizable to theoretical propositions and not to populations or universes"* (Yin 2009, p. 15). The complex environment, changing context and extensive variables within a case study are major challenges to make research findings applicable in other settings. Thus it is not the main aim of study to statistically test research findings amongst different manufacturing firms, instead develop the theories on how to analyze the barriers and benefits of integration process.

On the other side, Case Study Company sets a typical pattern for other manufacturing firms operating globally with various suppliers and customers all around the world in a complex supply chain. Hence, case can draw a general outline which might be further developed to fit more specific business needs. In addition, ISO 14001:2004 is a standard which is formed on the basis of generic PDCA cycle. Therefore, research findings might be generalizable to companies which go through similar steps.

7.2. RECOMMENDATIONS AND FURTHER RESEARCH

Environmental management systems received increasingly higher recognition and importance in business environment. Standardization bodies and governments have come a long way since adoption of environmental management systems. However, there are still a lot to do to enhance and facilitate integration of EMS to SCM.

It is important to define the scope and objectives of training programmes in line with proactive environmental strategies. In addition to basic training programmes, manager should continuously develop competence on state of the art environmental technologies, methods and strategies.

Companies should build stronger relations with chain members that facilitate and support integration of EMS to SCM. Companies will perform better when they are aware of higher benefits. There could be a premium payment or award system for best performing firms throughout supply chain that will foster EMS integration process.

Companies should enhance communication channels, use standardized methods to measure performance outcomes and monitor performance outcomes with standardized methods. More importantly, these methods should spread throughout supply chain that will subsequently enhance and facilitate better benchmarking of performance outcomes.

In this research, barriers and benefits of integrating EMS to SCM are investigated. Research is designed to be typical case for other companies who operate globally and face the same challenges and who might take the advantages of benefits. It will be highly important to do further research in different cultural context to generalize findings. In this research, a globally operating Swedish company is investigated. What might be barriers and benefits of integration for a company headquartered in another country? Moreover, this investigation could be expanded further to small and medium sized enterprises (SMEs) that are operating more locally or in a simpler supply chain environment. SMEs play a key role in economies and mostly barriers and benefits of integrating EMS to SCM might differ within their operating context.

EMS is a part of sustainability works and this study might be further expanded to corporate social responsibility. There could be further research on the benefits and barriers integrating CSR to SCM or how CSR works can be integrated to SCM; which tools or methods can be used to spread integration process throughout supply chain?

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APPENDIX

APPENDIX A - INTERVIEW QUESTIONS

HOW THE CASE COMPANY INTEGRATED EMS TO SCM?

1. Do you do any environmental educational and/or training/awareness activities for Supply Chain personnel and managers?
2. Do you have a policy of purchasing eco-friendly raw materials?
3. Do you have training programmes for suppliers and/or contractors to ensure that they meet environmental and product quality requirements?
4. Have you worked in a team with EMS/Supply Chain managers to improve the environmental performance of the company? If yes, please tell us difficulties and benefits of working in such a team.
5. Do you do environmental reporting? If yes, how often? Pls also inform us about accessibility of reports by employees and public.
6. How do you communicate environmental issues internally? (Employees, Top management, middle and lower management, etc.)
7. How do you communicate environmental issues to suppliers and customers?
8. Do you collaborate with customers to reduce environmental impacts of company activities? If yes, please tell us how you exchange information? Do you work in project teams with customers?
9. Do you share information and/or resources with EMS managers?
10. Do you do meetings with Supply Chain managers? What kind of meeting? (Teleconferencing, face to face meetings, etc.) How often?
11. How do you exchange information with EMS managers in any documented forms? (Reports, forms, booklets, fax, etc.)
12. Please circle the most appropriate option below that shows the level of your satisfaction with EMS/Supply Chain department?

- Very Satisfied
- Satisfied
- Not Satisfied
- Indifferent

- Very dissatisfied

WHAT KIND OF INTEGRATION IS PROVIDED?

1. Have you adapted an environmental friendly culture amongst Supply chain managers and workers?
2. Do you take into consideration environmental concerns in strategic decision making? If yes, please give us some examples.
3. Do you have common goals and vision with supply chain managers?
4. Do you think there is a mutual understanding between EMS managers and SCM managers?

WHAT ARE THE BENEFITS OF INTEGRATION PROCESS?

1. Since you implement ISO 14001 standards, have you improved supply chain environmental performance in following aspects?

- Reduction in waste generation
- Less water use
- Reduction in air emissions
- Reduce the noise caused during operations
- Compliance with laws and regulations
- Eco-friendly packaging (biodegradable, reusable, recyclable)
- Eco-friendly transportation

2. What are the benefits of meetings?
3. What are the benefits of sharing information and resources?
4. What are the benefits of having common goals and vision with EMS managers?
5. What are the benefits of collaboration with customers?
6. What are the benefits of internal communication?
7. What are the benefits of external communication?
8. What are the benefits of training suppliers and/or contractors?
9. Please tell us the benefits of education and training programmes.

WHAT ARE THE BARRIERS IN FRONT OF INTEGRATION PROCESS?

1. Are there any difficulties you faced before/during and/or after education/training programmes?
2. Are there any barriers in front of training programmes with suppliers and contractors?
3. What are the barriers in internal communication?
4. What are the barriers in external communication?
5. What kind of barriers you faced during collaboration with customers?
6. What are the barriers in front of having common goals and vision with EMS managers?
7. What are the barriers in front of sharing information and resources?
8. What are the barriers in front of doing meetings?

APPENDIX B – SANDVIK TOOLING ISO 14001 CERTIFICATE

DET NORSKE VERITAS

MANAGEMENT SYSTEM CERTIFICATE

Certificate No. 2007-SKM-AE-1202

This is to certify that

Sandvik Tooling

WORLD WIDE
Sites according to appendix

has been found to conform to the Management System Standard:

ISO 14001:2004

This Certificate is valid for:

Design, development, manufacturing, recycling, sales and distribution of tools, inserts and tooling systems for metal cutting, as well as carbide powder, wear parts and superabrasive components

Initial Certification date:
2007-01-29

This Certificate is valid until:
2013-01-31

The audit has been performed under the supervision of:
Doris Forsberg
Lead Auditor

SWEDAC ACKREDITERING

Place and date:
Stockholm, 2010-08-11

for the Accredited Unit:
DNV CERTIFICATION AB,
SWEDEN

Ann-Louise Pått
Management Representative

Lack of fulfilment of conditions as set out in the Certification Agreement may render this Certificate invalid.

APPENDIX C – SANDVIK TOOLING LETTER TO SELECTED SUPPLIERS

Letter to selected Suppliers (quality and sustainability aspects)

Sandvik … *(relevant entity)* has developed it's working practices including concrete action plans with the objective to increase it´s quality, environmental and social performance.

Our policy is to conduct our sourcing in an environmentally and socially responsible manner. To secure this, we review our supplier´s performances on a regular basis.

We kindly request that you, as a supplier to Sandvik, return the completed and signed questionnaire before xx-yy-zz

If you need any further information, please do not hesitate to contact us. We will be pleased to answer your questions.

Yours Sincerely,

.....
(name of responsible Buyer)
(Sandvik entity)

APPENDIX D – QUESTIONNAIRE FOR SUPPLIERS NOT HOLDING ISO 14001 CERTIFICATES

Questionnaire

To be filled in for companies not holding an ISO 14001 certificate

		Yes	No
1	Do you have a plan to be certified to ISO 14001? *If yes, estimate time to achieve certification*		
2	Do you have an Environmental Policy? *If yes, please forward a copy of the Policy*		
3	Have you assessed the Environmental impacts of its industrial activities? *If yes provide details*		
4	Do you have any documented corporate environmental objectives? *If yes provide details*		
6	Do you have procedures in place to perform internal Environmental Audits?		
7	Do you conduct any environmental awareness training for your employees?		
8	Do you hold a valid permit from the relevant Authorities in the country you operate to perform industrial activities?		
9	Have you been subjected to any adverse remarks from the Environmental Authorities in the country you operate?		
10	Do you use any banned or hazardous substances in your production?		
11	Do you have an environmental supply chain process in place, which requires your key suppliers to improve their environmental performance?		
12	Do you provide environmental information or data sheets for your products?		
13	Do you submit Environmental Reports on a regular basis to any official authority in the country you operate?		