Engaging Service Providers in Continuous Improvement

How Volvo's actors, systems and chemical management service provider could work together towards continuous improvement and sustainable development.

Douglas Helman

Supervisors:

Torbjörn Brorson

Martin Kurdve

Thesis for the fulfilment of the
Master of Science in Environmental Management and Policy
Lund, Sweden, September 2007

iiiee

Published in 2007 by IIIEE, Lund University, P.O. Box 196, S-221 00 LUND, Sweden,
Tel: +46 – 46 222 02 00, Fax: +46 – 46 222 02 10, e-mail: iiiee@iiiee.lu.se.

ISSN 1401-9191

Acknowledgements

"Has the sheep eaten the flower? …no grown-up will ever understand that this is a matter of such importance!" Antoine de Saint-Exupérys very deep question (from The Little Prince) sometimes distracted me from the process of completing this master's thesis. I couldn't help but wonder what the answer to that question might be. And so it was with my thesis questions too. Until, finally, a group of wise industry people confirmed that, what I thought might be a naïve and simplistic solution was in fact, a viable and realistic proposal.

On that note I express thanks to the many people at Volvo Technology, Volvo Construction Equipment's Component Division, Volvo Non-Automotive Purchasing and BP Castrol who shared their knowledge and experience of the real world of automotive manufacturing with me, not to mention their time and patience.

Special thanks to Martin Kurdve who contributed significantly to guiding me to a valid business solution – I hope to see it implemented! For your efforts in putting me in touch with the right people at the right time (before everyone took a summer break), I thank you very much.

To Torbjörn Brorson, your wisdom and experience in industry was invaluable for the completion of this work. Your understanding of the business perspective helped me to create a document intended to be read by industry (maybe it's still a bit long!).

Evidently, spending a year with non-native English speakers does *not* do wonders for a native speaker's English. I'd like to extend gratitude to the strange guy in Brunius Café, who informed me of my 'bad English,' and to my Mum for confirming that my English actually was getting worse. On that note, Mum, you did a wonderful job proofing this work and correcting my 'bad English.'

Eva, when it was just that little bit too hard, you reminded me that life was not only about writing a master's thesis, that The Little Prince and Ronia the Robbers Daughter could also teach us something about those things which are really important.

Abstract

Continuous improvement is not a new idea in business. Six Sigma, Lean Production and the PDCA cycle are some of the approaches companies can take to conduct continuous improvement of their operations. However, when a buyer is engaged with a supplier via a service provision contract, their combined effort to work towards continuous improvement is made more complex. This research adds to the understanding of how a large business could engage its supplier in continuous improvement, specifically where a service provision contract exists between the buyer and supplier. A case study at Volvo Construction Equipment revealed that a number of actors and systems, that fulfilled the theoretical requirements for a successful engagement, already existed. This allowed for the proposal of a solution to Volvo Construction Equipment concerning the best way for them to engage with BP Castrol, their chemical management service provider.

Executive Summary

Volvo Construction Equipment Component Division (VCE CMP) is in the process of increasing the capacity of its production facility at Eskilstuna. The process revealed an opportunity to conduct and implement radical redesign of the chemical handling/management system such that its environmental and economic performance could be improved. The situation is made more complex by a chemical management service contract between VCE CMP and BP Castrol, its chemical management service provider. This contractual relationship has created some uncertainty about how VCE CMP should engage BP Castrol in conducting system redesign and upgrade.

At the same time, Volvo Technology (VTEC) is in the process of developing a lean production system for all of the Volvo Group's production operations – the Volvo Production System (VPS). This system will drive the continuous improvement of activities conducted within the Volvo Group, including at VCE CMP. In light of the VPS development, and the realisation that the investigation would conclude too late to affect the decisions made for the Eskilstuna upgrade, the focus was placed on investigating how VCE CMP should engage BP Castrol in the continuous improvement of the chemical handling/management system.

The purpose of this research was to build an understanding of how a large business could engage its service providers in continuous improvement. Of particular interest was the interaction between business approaches to continuously improving and sustainably developing manufacturing processes in the case where a service provision contract exists between a buyer and supplier. A case study was conducted at VCE CMP to determine the most appropriate organisation of actors and systems to ensure the continuous improvement of the chemical handling/management system.

Analysis revealed that VCE CMP's and BP Castrol's existing actors and systems satisfied the theoretical requirements for a successful engagement between them as indicated in the table below:

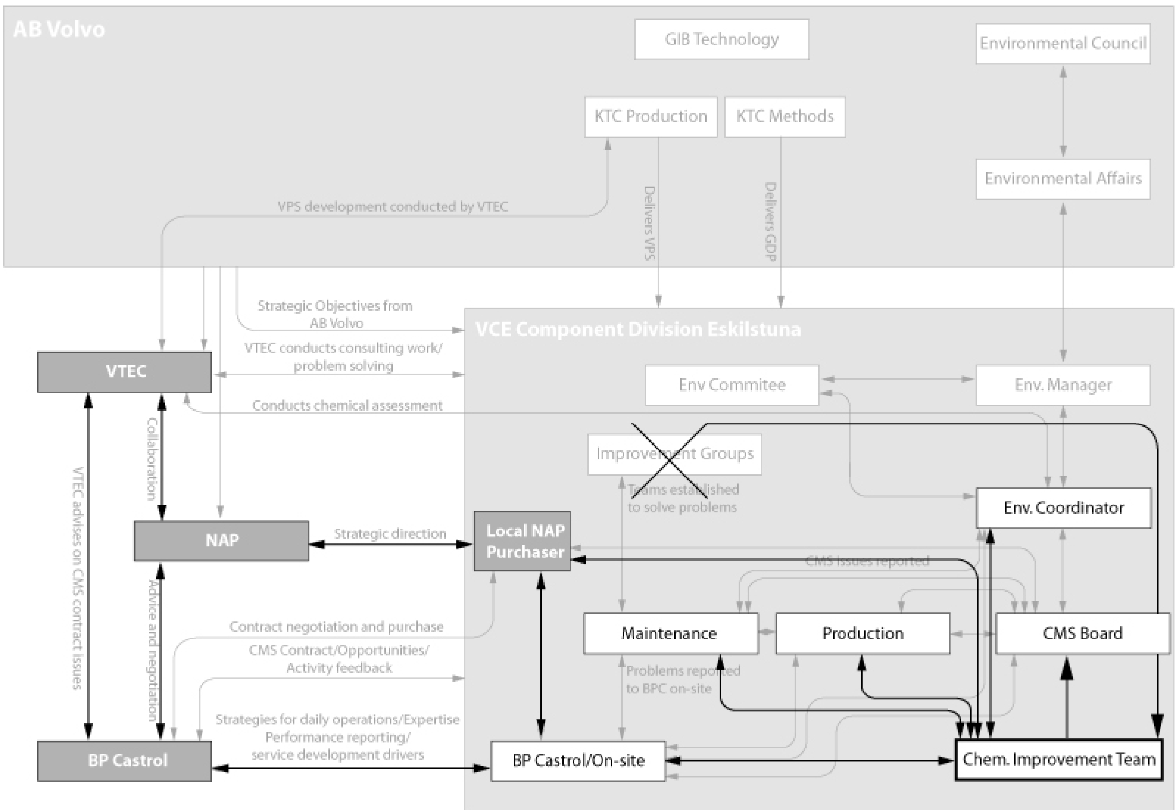
Theoretical Attribute	Presence in the Volvo Case	Strength/ Weakness
Involve all employees (Kaizen, lean production, TPM, ISO 14001, ISO 9001)	• Volvo Group policy documents explicitly state that all employees should be involved in the continuous improvement of Volvo operations.	Strength
	• The VPS relies on the involvement of all.	Strength
Based on the Plan-Do-Check-Act (PDCA) cycle (Kaizen, lean production, ISO 14001, ISO 9001)	• Continuous improvement within the VPS framework is conducted according to the PDCA cycle.	Strength
	• Both VCE CMP and BP Castrol are certified according to ISO 14001:2004 and ISO 9001:2000, ensuring their familiarity with the PDCA cycle.	Strength
Based on team work (permanently formed teams) (Kaizen, six sigma, lean production, supplier integration, supplier development, 'closeness')	• Eskilstuna's improvement groups and Chemical Management Service Board are some form of continuous improvement teams.	Strength
	• Teamwork is one of the five principles of the VPS – specifically cross functional, goal-oriented teams.	Strength

Goal – eliminating waste (Lean production, six sigma, ISO 14001)	• Volvo Group environmental policy specifically aims to improve resource efficiency – the result of eliminating wastes. • Environmental management system and quality management system certifications aim to eliminate wastes in various forms. • The VPS aims to eliminate various forms of waste.	Strength Strength Strength
Maximising overall equipment efficiency (TPM)	• BP Castrol works with production and maintenance to improve the efficiency of machinery through improved process chemical use.	Strength
Culture of continuous improvement (Kaizen, lean production, ISO 14001, ISO 9001)	• VPS will create a culture of continuous improvement. • Environmental management system and quality management system certifications create a culture of continuous improvement.	Strength Strength
Life cycle perspective (ISO 14001)	• The environmental policy requires a life-cycle perspective for products and processes.	Strength
Material substitution (ISO 14001)	• Substitutionprojekt section, within the internal chemical assessments database, allows for recording information about substitution projects. • The Black and Grey lists drive VCE CMP's and BP Castrol's efforts in the substitution of hazardous chemical substances for less hazardous alternatives.	Strength Strength
Joint problem solving (Supplier integration, operational knowledge transfer activities)	• Eskilstuna's Improvement groups and CMS Board are an existing form of teams conducting joint problem solving. • The VPS requires that suppliers are involved in process design and that cross functional teams should conduct problem solving	Strength Strength
Long term commitment (Supplier integration, supplier development, operational knowledge transfer activities)	• Non Automotive Purchasing (NAP) works to establish long term relationships with preferred suppliers. • Since the Black and Grey lists drive BP Castrol's product selection and development, BP Castrol is committing itself to a long-term relationship with VCE.	Strength Strength
Direct involvement (Supplier integration, supplier development, operational knowledge transfer activities, closeness, technological integration and innovation)	• NAP views suppliers as an extension of Volvo. • Quality policy calls for close links with suppliers.	Strength Strength
Close relationship (Supplier integration, supplier development, operational knowledge transfer activities, closeness, technological integration and innovation)	• BP Castrol works with VCE CMP production to optimise performance. • The Black and Grey lists drive BP Castrol's actions, strengthening the commitment between VCE CMP, NAP, VTEC and BP Castrol.	Strength Strength

These findings led to the following conclusions being drawn for the Volvo case:

- Management must provide clear direction for continuous improvement by contributing to goal setting for continuous improvement and sustainable development.
- Continuous improvement actions should be taken in response to the environmental and quality policies.
- The definition of continuous improvement is not clear.
- The value of teamwork is well established even though it is not necessarily classified according to Volvo Group's operational development system.
- Continuous improvement work should be conducted by a team in accordance with the ISO 14001:2004 certification under the umbrella of the VPS.
- The Chemical Improvement Team should contain representatives from the environmental (ISO 14001) and quality (ISO 9001) departments or, in future, a representative from the business management system department.
- The Chemical Management Service Board should act as a link between the Chemical Improvement Team and VCE CMP top management.

In addition, in direct response to the research question, '*how should the actors and systems of Volvo and their chemical management service provider be organised to ensure continuous improvement of the chemical handling/management system at Eskilstuna?*' the following model was proposed:



This model of engagement between VCE CMP and BP Castrol proposes the creation of a Chemical Improvement Team (CI Team). This team would utilise the experience of previously formed improvement groups and should consist of representatives from the environmental department, production/quality departments, maintenance, BP Castrol, local NAP and any additional expertise as required. They should act on a local level, at Eskilstuna, and conduct improvement work according to the PDCA cycle. The CI Team should report to the CMS Board who reports to VCE top management. And, VTEC and NAP should provide expertise as needed to both VCE CMP and BP Castrol.

A focus group, conducted at VTEC, was used to discuss the relevance of the proposed model and it was agreed that the model could be successful for engaging BP Castrol in the continuous improvement of the chemical handling/management system at Eskilstuna. Implementation will confirm whether this is in fact true.

The Volvo case highlights a number of conclusions which contribute to understanding the engagement between a buyer and supplier. In the case where a service contract exists between them it was concluded that:

- Continuous improvement work can theoretically be carried out by teams working within an EMS and in conjunction with a lean manufacturing style production system.
- One definition of continuous improvement must be clearly established and communicated to all relevant actors in both the buyer and supplier companies.
- Companies should not duplicate improvement systems.
- Service providers must be empowered to contribute to improvement projects at the buyer organisation.
- Key performance indicators should be established, monitored and reported to measure the quality of improvement work.
- Service providers must maintain a 'close' relationship with the buyer organisation to enable joint problem solving in cross functional (and cross company) teams.
- Company policies must drive continuous improvement work.
- Management commitment, in providing clear targets for continuous improvement work, is essential for success.

Through studying the Volvo case a theoretical model of engagement between a buyer and supplier, working towards continuous improvement, was developed. The existence of the model elements were identified within the Volvo Group and BP Castrol allowing for a solution to be presented regarding the best organisation of actors and systems. Testing of the proposed solution in a focus group revealed that, not only did the organisational model present a realistic solution, it could also be applied to other cases where a service provision contract existed between a Volvo Group company and a service provider.

Table of Contents

List of Figures

List of Tables

1 Introduction

Research conducted in conjunction with a company presents many challenges and rewards. Perhaps the most beneficial aspect of such work is that the results can be implemented to make a positive change within an organisation. This research, conducted in conjunction with the Volvo Group, Sweden, is an investigation of a real world issue intended to provide a solution to the participating organisation and to provide a case of reference for other organisations in a similar situation.

This chapter introduces the purpose of this research, sets the scope and limitations and describes the methodology used to conduct this investigation. To begin, a background of the case is provided.

1.1 Background

The Volvo Group is a Swedish supplier of commercial transport solutions. In 2006 sales rose to 248 billion SEK (approx. €26.8 billion) and the number of employees reached just above 83 000 in 58 countries across Europe, Asia and North and South America (Volvo, 2006b). Transport solutions provided by the Volvo Group include buses, trucks, construction equipment, drive systems for marine and industrial applications, aircraft engine parts and financial services.

One of the Volvo Group companies, Volvo Construction Equipment (VCE) is in the process of expanding its Component Divisions (VCE CMP) production site at Eskilstuna. The budget for this expansion is approximately 1.1 billion SEK (approx. €120 million) and will see the production capacity of Eskilstuna double by the end of 2009 (termed the CS09 - Component System 2009). During the CS09 development process, it became apparent that an opportunity existed to undertake significant redesign of the chemical handling/management system. However, this prompted questions about how VCE CMP should be organised in order to interact with its chemical management service (CMS) provider (BP Castrol) to conduct such redesign. Furthermore, in light of the recent development of the Volvo Production System (VPS), a lean production type system, questions have been raised regarding the way in which VCE CMP and other key actors should be organised to ensure the continuous improvement of the chemical handling/management system at Eskilstuna.

According to Volvo Group environmental and quality policies and the environmental requirements placed on Volvo Group production sites, any changes to the chemical handling/management system at Eskilstuna should contribute to the overall goals of AB Volvo (Volvo Group's corporate entity) and VCE. They should also take into consideration the health and safety of workers, environmental issues and profitability, in line with triple bottom line thinking. Traditionally, improvements to the chemical handling/management system might have been carried out by design engineers or by production or maintenance personnel, since they possessed the necessary skills and knowledge to conduct such work. However, with a CMS contract now in place, such that BP Castrol is responsible for the supply and management of chemical products for Eskilstuna, it is unclear who should be responsible for aspects of continuous improvement work. In light of this, VTEC has identified two key issues for investigation:

1. On a local level, VCE CMP is not sure how best to engage with BP Castrol to ensure continuous improvement of the chemical handling/management system at Eskilstuna.

2. On a broader level, the Volvo Group would like to gain a deeper understanding of how to engage service providers when Volvo improvement actions affect the actions of the service providers.

These issues set the foundation for this investigation into VCE CMP's engagement with BP Castrol towards continuous improvement. It should be noted that the term 'continuous improvement' was used interchangeably by interviewees with the term 'sustainable development.' For this reason, in this thesis, the term 'continuous improvement' also refers to 'sustainable development.'

1.2 Purpose

The purpose of this research was to build an understanding of how a large business could engage its service providers in continuous improvement. Of particular interest was the interaction between business approaches to continuously improving and sustainably developing manufacturing processes in the case where a service provision contract exists between a buyer and supplier. In order to gain detailed knowledge of this interaction, a case study at VCE CMP at Eskilstuna was conducted. The case study aimed to address two questions:

1. *How should the actors and systems of Volvo and their chemical management service provider be organised to ensure continuous improvement of the chemical handling/management system at Eskilstuna?*

2. *In what ways would the solution differ, in order to make it applicable to other scenarios where services are provided?*

A number of sub-questions were used to guide this research. While the answers to individual questions are of interest to the case participants, other audiences may be more interested in the general conclusions drawn by this research. The following sub-questions were addressed:

- How is 'continuous improvement' defined by the different actors and systems?
- How are the actors and systems currently organised to work towards continuous improvement?
- What are the links between the actors and systems?
- How are continuous improvement activities related to the environmental management system (EMS)/business management system (BMS)?
- Which actor and system elements exist, within Volvo Group and BP Castrol, to fulfil the requirements of a theoretical model for engaging service providers in continuous improvement?

1.3 Context

Companies are in the business of making money to support their activities, ensure continuous growth and provide a return on investment to their shareholders. When thinking about business managers 'the simplest assumption one can make…is that they are trying to maximize the firm's value…' (Reinhardt, 2000). From this very simple assumption the first context was formed. The research must fit into the existing paradigms of business strategies, operations and objectives; maximising a firm's value.

Volvo Construction Equipment is currently investing in expansion of the Eskilstuna production facility. This expansion has presented project planners with an opportunity to rethink the chemical handling/management system. A major opportunity exists to improve the technical design and economic and environmental performance of the currently decentralised system. However, due to the involvement of a chemical management service provider, it is not clear how improvement work should be undertaken. In this respect one of the major contexts was that of infrastructural change and the potential accompanying organisational and relational changes within and between VCE CMP and their CMS subcontractor.

This potential change in relationship determined the third context; business decision-making. As Vandenbosch (2003) points out; managers lack the time, resources or understanding of processes to solve ambiguous problems and address the endless stream of opportunities. It was, therefore, necessary to approach this research from an angle where the goal was to present a solution to solve a business problem.

Finally, it is worth noting that this research has been commissioned by the Environment and Chemistry group within VTEC. As Volvo Group's internal consulting group, it is apparent that this research forms part of their consulting work. In addition, the author is one step further removed from the company by acting as a consultant to VTEC. The advantage of this arrangement is that consultants are not so closely linked to the company they are working for and, therefore, are not affected by the '…day-to-day power, politics, groupthink, and myopia…' (Vandenbosch, 2003) that ultimately affect an organisation.

1.4 Scope

This investigation was initiated and guided by a representative from VTEC. This individual is responsible for managing process media infrastructure development, at Eskilstuna plant, including chemical handling/management system improvement.

A number of Volvo Group companies were investigated for this research. No organisational limitations were established though it is acknowledged that the focus fell on organisations within the Volvo Group as well as one key supplier, BP Castrol. In addition to the roles of individuals and organisational units, the systems in which they operate were of key importance.

At the start of this research two scenarios for investigation were present. The first scenario involved improving the long term performance of Eskilstuna's chemical handling/management system, through major redesign and upgrade, as part of the CS09 project. The second scenario was centred on conducting continuous improvement work to ensure the long term development of that system.

As indicated in the Background (Section 1.1), this research was initiated as a result of the expansion of Eskilstuna and focused on the opportunity to improve the long term performance of the chemical handling/management system at that facility. This facility is under the management of VCE CMP. A map of the key organisational units is shown in Figure 1-1. AB Volvo is the corporate organisation of the Volvo Group. The next level down represents the different business areas (BAs) within the Volvo Group, one of which is VCE.

Within VCE there are a number of work areas one of which is the Product, Technology and Industry group. It is in this group that the Component division is nested.

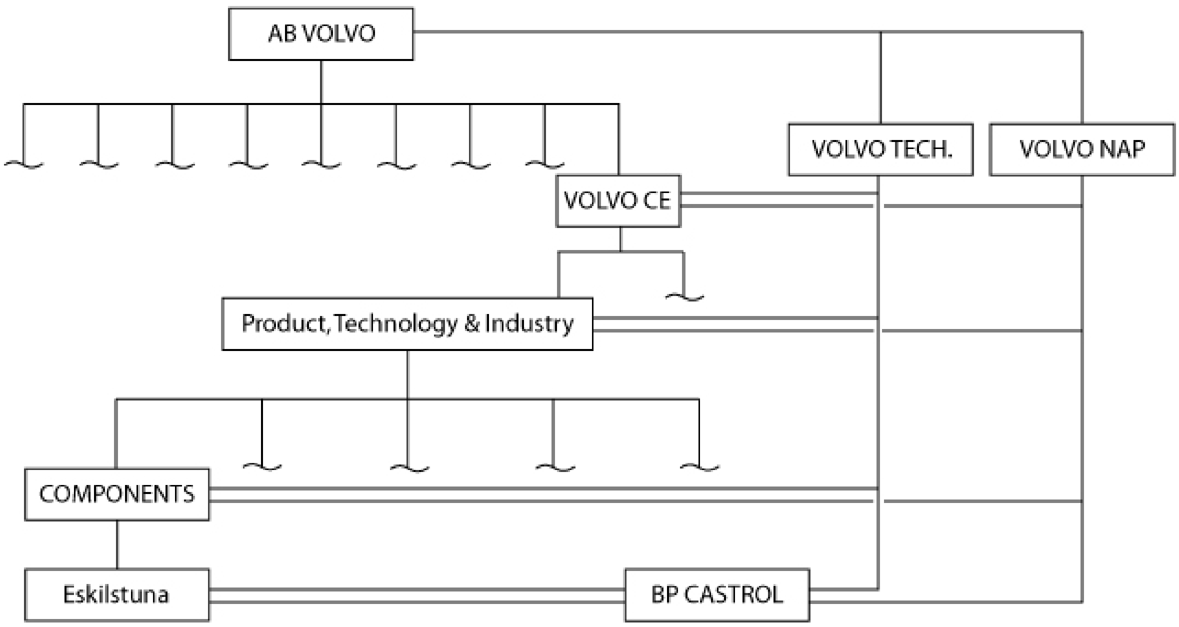


Figure 1-1 Organisational Scope

Two other key groups are Volvo Technology (VTEC), for whom this research was conducted, and Non-Automotive Purchasing (NAP).

1.5 Limitations

Due to the qualitative nature of this research (further described in Section 1.6) it is acknowledged that the findings of this research are an interpretation of the issues presented in the Volvo case. This interpretation is shaped by personal experiences as an industrial designer within a small engineering and manufacturing firm.

Since the author lacked an understanding of the Swedish language, only documentation written in English was reviewed. It is noted, however, that the majority of documents determined for review were written in English.

1.5.1 The Environmental and Quality Perspective

It is acknowledged that the quantity of actors and systems that influenced this case far exceeded time, resource and access capacities of this research. With progression of the investigation, it became apparent quickly that, with every system, a subsystem and numerous other actors emerged. With this in mind, this research reveals only one perspective of actors and systems; the environmental and quality perspective with concern for chemical reduction and substitution. It is believed, however, that the research presented here addresses those actors and systems that hold the largest influence over the Eskilstuna case.

1.5.2 Radical Change or Continuous Improvement

As pointed out in the Scope (Section 1.4), two scenarios were presented for studying the improvement of the chemical handling/management system at Eskilstuna. During the course of this research it became apparent that the results would be presented too late to affect actions taken, regarding the chemical handling/management system at Eskilstuna, within the CS09 project. With this in mind the decision was made to focus on how to engage service providers in continuous improvement activities rather than through radical change.

1.5.3 Application of Findings

Since data gathering centred on the problem presented at VCE CMP's plant at Eskilstuna, the findings presented here are specific to that situation only. The conclusions drawn are based on the discoveries made at Eskilstuna and should not automatically be considered as representative for other Volvo Group operations or the operations of companies outside the Volvo Group.

An attempt was made to gain a broader understanding of the ways in which service providers could be engaged to work on continuous improvement. It is acknowledged that, since this analysis was based on the situation presented at Eskilstuna, the results should be viewed with caution and respect for the very specific nature of that situation. Any attempt to apply what was learnt through this research should be scrutinised to test the applicability to other situations.

1.6 Methodology

Volvo is having difficulty understanding the issues presented in Section 1.1 and so case study research was chosen because its purpose is to make this particular case understandable (Stake, 1995). Alloway (in Gummesson, 2000, p. 86) confirms that "when the audience are managers who must implement findings," case research is especially appropriate. This section outlines the choice of methodology, justifies that selection and describes the phases of this study.

Maintaining a holistic view is the most important aspect of this research design. Schwandt (in Stake, 1995, p. 43) notes that one of the key characteristics of qualitative inquiry is its emphasis on maintaining a holistic view of phenomena. When conducting this type of research it is also important to maintain the focus on the whole, as the central object of study, rather than on its constituent parts (Gummesson, 2000). The whole, for this research, consisted of the organisation, actors and systems within Volvo Group companies plus the relevant organisation, actors and systems of BP Castrol.

In order to answer the proposed research questions, the selected methodology was drawn from two major research approaches. Firstly, this research was of an applied nature insofar as it was intended to lead to a solution for a specific problem as identified by a client (Easterby-Smith, Thorpe, & Lowe, 1991). Secondly, it can also be classified as an "instrumental case study" because it was intended to be instrumental in accomplishing something other than understanding (Stake, 1995) – in this case assisting in the implementation of continuous improvement work.

With this in mind, Figure 1-2 is a graphical description of the design of this research. Key elements of the research design include the separation of work into two distinct phases. Phase 1 focused on gathering empirical evidence from Volvo Group in addition to theoretical findings from literature, the analysis of these two groups of findings and the generation of criteria for successful engagement between a buyer and service provider working towards continuous improvement. Phase 2 centred on the development of a possible solution to the first research question. Ultimately, recommendations were delivered to Volvo Group regarding the most effective way to organise the actors and systems in order to conduct continuous improvement.

One of the key advantages of this research design was the separation of development, testing and delivery of recommendations (Phase 2) from the gathering and analysis of theoretical and empirical findings (Phase 1). One of the key problems with this type of research is that the questions asked are sometimes designed to fit with some pre-existing goal rather than being instrumental in achieving it. It was, therefore, important that the analysis of findings was not influenced by the desire to achieve a certain goal. Detailed explanations of the tasks in each phase are provided below.

Phase 1

Task 1: To **understand** Volvo Group's definition of 'continuous improvement.' This task was achieved through gathering information from Volvo documentation, interviews and literature review.

Task 2: To **identify** the way in which VCE CMP currently conducts continuous improvement and whether or not the actors, systems and organisation are effective. This task was conducted on-site at VTEC in Göteborg, and VCE CMP in Eskilstuna, and involved gathering information from Volvo Group documentation and interviews.

Task 3: To **identify** the actors and systems involved with decision-making. This task was conducted on-site and achieved through interviews and subsequent review of Volvo Groups internal systems via their intranet.

Task 4: To **establish** theoretical findings that demonstrated prior knowledge related to the research issues. It was conducted at this stage due to the fact that it was not apparent what the appropriate areas of investigation were, until after initial discussions with the involved actors.

Task 5: To **analyse** the empirical findings (Tasks 1-3) against the theoretical findings (Task 4).

Task 6: To draw **preliminary conclusions** regarding which actors (internal and external) and systems would be most appropriate for conducting continuous improvement work. The conclusions presented here were based on the analysis conducted in Task 5 and formed the starting point for the development of a possible solution as described in Task 7.

Phase 2

Task 7: To **develop** a potential organisation of actors and systems to conduct continuous improvement. This task involved developing a conceptual model based on the conclusions presented at finalisation of Phase 1.

Task 8: To **test** and **develop** the proposed solution with key actors. This task was achieved through a focus group conducted at VTEC involving VTEC, VCE CMP and NAP personnel.

Task 9: To deliver **recommendations** to Volvo in direct response to the proposed research questions.

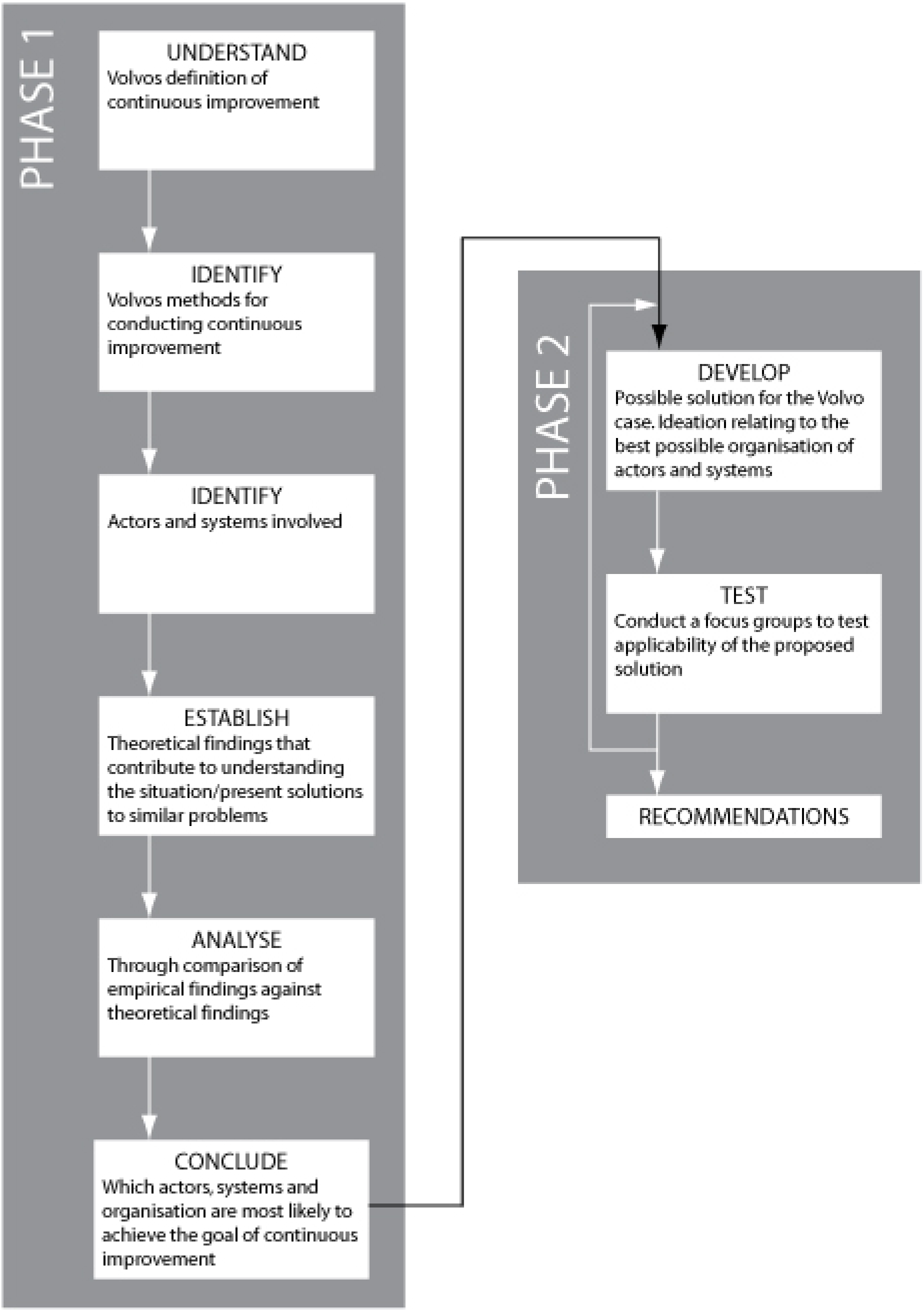


Figure 1-2 Research Phase Design

1.7 Data Gathering

In line with instrumental case study research, the chosen data gathering techniques placed the importance of research not on the case itself but rather on the issues, problems and concerns, raised through study of the case (Stake, 1995). With this in mind, three data gathering techniques were employed. Firstly, review of Volvo Group documentation was used to gather insights into the actors and systems within the Volvo Group. Literature review was used to gain insights from academic literature. Secondly, informal, semi-structured interviews were utilised to gather primary data. Finally, a focus group was conducted to evaluate and discuss the proposed solution.

1.7.1 Literature Review

An initial review of literature was conducted to establish a body of knowledge against which the findings of empirical data gathering could be compared. Due to the wide range of research areas associated with this case, for example a large body of work exists on integration of different approaches to quality in addition to the work on the respective approaches, a number of key research areas were selected. The decision was made to limit this review by considering the areas of research that appeared most likely to present a possible solution for the Volvo case. In other words, only the research areas that could contribute to answering one or both of the research questions were considered. To arrive at this decision, a mind map of all the possible research areas was drawn up as a guide to conducting the interviews. After gathering empirical data, through interviewing, the list of research areas could be revised down to only those that were appropriate and could contribute to solving the problem. The original list and final list of research areas are shown in Table 1-1.

Table 1-1 Literature review research areas

Initial list of research areas	Final list of research areas
Environmental management systems (ISO 14001)	Sustainable development principles
Product oriented EMS	Kaizen
The Natural Step	Six Sigma
Cleaner Production	Lean Manufacturing
Ecological foot printing	Total Productive Maintenance
Environmental reporting	ISO 14001 Environmental Management System
Green supply chain management	Integrated ISO 14001, 9001 and 18001 Systems
Chemical management services	Integrating ISO 14001 and Lean Production
Performance measurement	CMS as a Product-Service System
Tools for infrastructure strategy	Supplier Integration
Organisational design	Supplier Development
Environmental co-makership	Operational Knowledge Transfer Activity
	Buyer-Supplier Closeness
	Technological Innovation and Integration

It was determined that in order to contribute to academic knowledge, while providing recommendations to Volvo, the empirical data should be gathered before the literature review. By conducting empirical data gathering (as outlined in the next section) a picture of the case could be drawn to better understand the areas requiring attention and those that were outside the scope. In essence, the empirical data refined the scope. Only by structuring the research in this way could the appropriate theories be gathered from literature.

1.7.2 Interviews

The most significant choice of data gathering techniques was the decision to conduct informal, semi-structured interviews. In order for a researcher to influence an issue, it is necessary for him/her to build an understanding of the respondents 'world' (Easterby-Smith et al., 1991). This method of data gathering presents a number of significant advantages. For example, this type of interview typically results in the interviewer obtaining 'interesting extras' in addition to all the data needed (O'Leary, 2005, p. 116). The interviewer can build rapport and trust by bending the roles typically associated with the formal interviewer and interviewee, thereby encouraging communication (O'Leary, 2005, p. 116). These characteristics were essential to successfully complete this research. Those being interviewed, and who would eventually implement the recommendations made, needed to trust that the recommendations delivered were built on reliable and valid techniques.

Recent developments in interview techniques revealed one very specific form of semi structured interview that was appropriate for this study. This type of interview is called an expert interview. The Volvo case presented a large number of individuals involved with each other, and with systems, in complex ways. In this case it was less important to focus on the relationships and personal stories typically at the centre of qualitative studies and particularly as the focus of interviews. Instead, in line with expert interviews, the interviewee was of less interest as a person but more so for their expertise in a particular field of activity (Flick, 2006, p. 165).

In line with the decision to conduct expert interviews (informal, semi structured), key individuals within specific areas of activity were identified for interviews. These individuals were chosen based on their position in the Volvo Group, their roles within particular systems of interest and/or their potential to be involved in the identified issues/solution. The individuals interviewed were:

- Helene Niklasson, Manager of Environment and Chemistry, VTEC, Göteborg.
- Martin Kurdve, Project manager for process media infrastructure development at Eskilstuna plant, client and supervisor, VTEC, Göteborg.
- Bert Hill, Volvo Production System, Project Area Manager, VTEC, Göteborg.
- Anne-Marie Rydström, Project Manager for Coolant and Development, VTEC, Göteborg.
- Ragnhild Brun, Volvo Chemical Assessment Coordinator, VTEC, Göteborg.
- Robert Svensson, Global Environmental Coordinator for 3P Product Development, VTEC, Göteborg.
- Johan Svenningstorp, Member of VPS Academy, VTEC, Göteborg.
- Niklas Axelsson, Global Strategic Buyer, Chemicals, Volvo Group NAP, Volvo Business Services AB, Göteborg.
- Tero Stjernstoft, Production Engineering Manager, VCE AB, Component Division, Eskilstuna.
- Mikael Johansson, Technical Manager Maintenance and Tools, VCE AB, Component Division, Eskilstuna.
- Sofia Westerberg, Environmental Coordinator, VCE AB, Component Division, Eskilstuna.
- Pauli Mattila, Production Leader TMD, VCE AB, Component Division, Eskilstuna.
- Josef Schiöler, Global Methods and Standards Manager Volvo 3P, Volvo Trucks, Göteborg.
- Adrian Higgins, TNA Manager, BP Castrol, Industrial Lubricants and Services,

1.7.3 Focus Group (Workshop Session)

To test the applicability and validity of the proposed solution a focus group was conducted at VTEC, Göteborg. A focus group is a form of group interview where several participants discuss a well-defined topic guided by a moderator (Bryman, 2004, p. 346; Morgan, 1998, p. 1). They are used to gather information regarding the participants experiences (Morgan, 1998, p. 11) and allow researchers to study the way in which a group of individuals collectively construct meaning around a particular phenomenon (Bryman, 2004, p. 348). In addition, as Bryman (2004, p. 346) points out, focus groups emphasise a particular topic and aim to explore that topic in depth.

According to Morgan (1998, pp. 31-33) there are two key aspects which characterise focus groups. Firstly, they are focused, meaning that they are concentrated on addressing a well-defined purpose. In light of this, it is possible to obtain large amounts of carefully targeted data within a relatively short period of time. Secondly, focus groups are a form of group discussion where details about the individuals are of little importance. Instead, the focus is on engaging participants in comparing their opinions and experiences of the topic. Bryman (2004, p. 349) adds that there is an interest in gaining a range of opinions about the topic.

Focus groups are typically used in four situations; problem identification, planning, implementation and assessment (Morgan, 1998, p. 14). The Volvo case required a focus group to assist in the planning stage requiring that the group find the best way to attain a desired situation. Morgan (1998, p. 59) also notes that focus groups are especially useful when trying to determine whether a program will satisfy the needs of those affected. In this research, the focus group was used for exactly that purpose – to determine whether the proposed solution would satisfy the needs of the affected actors and would likely achieve the desired goals.

One of the major limitations with the use of focus groups is that the moderator can significantly influence the data produced by the group (Morgan, 1998, p. 53). Morgan suggests that focus group results are directly related to the talents, preparation and attentiveness of the moderator highlighting the fact that the choice of moderator is of high importance. It should be pointed out that one major limitation of the focus group conducted for this study was that the moderator was not specifically trained in conducting focus groups. With respect to moderator participation, moderators should be wary of participating too much or too little and should allow discussion to flow freely while also intervening to address particular issues (Bryman, 2004, p. 353). While it is important to allow the discussion to occur naturally it is also important to keep the discussion on the topic.

Participant selection is also of critical importance for a successful focus group outcome. In theory, anyone who is related to the topic for research can be a focus group participant (Bryman, 2004, p. 353). However, as Bryman (2004, p. 353) also notes, it is important to select participants based on their age, gender, education, occupation or some other criteria. In this case, participants were selected based on their area of expertise such that the group contained representatives from the key actor groups and system groups identified in the proposed solution.

After selection of participants was complete, briefing notes were distributed outlining the purpose of the focus group and providing the necessary information to prepare participants to contribute to the workshop. The briefing document also outlined the questions for discussion that would be presented during the focus group to allow participants time to prepare their responses.

The focus group (presented as a workshop session) was successfully run on the 14th of August 2007 at VTEC in Göteborg from 1100 until 1530. The following individuals were in attendance for whole or part of the workshop session:

For the morning session 1100-1200

- Douglas Helman, Masters student, EMP, IIIEE, Lund, Sweden
- Martin Kurdve, Project manager for process media infrastructure development at Eskilstuna plant, client and supervisor, VTEC, Göteborg.
- Helene Niklasson, Manager of Environment and Chemistry, VTEC, Göteborg.
- Bert Hill, Volvo Production System, Project Area Manager, VTEC, Göteborg.
- Josef Schiöler, Global Methods and Standards Manager Volvo 3P, Volvo Trucks, Göteborg.

Afternoon session 1300-1530:

- All the above plus;
- Henrik Kloo, Project Area Manager for Sustainability and Environmental Technology, VTEC, Göteborg.
- Sofia Westerberg, Environmental Coordinator, VCE AB, Component Division, Eskilstuna. – via phone
- Peter Johansson, NAP Eskilstuna local purchasing – via phone

The morning session (1100-1200) session was introduced by Martin Kurdve who outlined the origins of the investigation and then introduced some of the key issues. Douglas Helman then further discussed some of the key findings as outlined in the Workshop Session Briefing Notes distributed to session attendees.

The afternoon session was attended by Sofia Westerberg and Peter Johansson by phone. Some important issues were outlined again briefly for their benefit and then Douglas Helman continued discussing the issues outlined in the briefing notes. After some time, Douglas began discussing the way in which the proposed solution was developed and then the solution was presented. Discussion around the Discussion Questions followed with valuable input from all attendees.

The session was concluded at approximately 1530. Participants were thanked for their time and input.

1.8 Thesis Outline

This chapter outlined the background for this research, its purpose, scope, limitations and methodology. Chapter 2 introduces the Volvo Group as the basis of the case study. Business approaches to continuously improving and sustainably developing manufacturing, as drawn from literature, are presented in Chapter 3. At the end of that chapter, a theoretical model of buyer-supplier engagement is suggested. Following this, in Chapter 4, the findings of the

Volvo case are simultaneously presented and analysed resulting in a summary of the presence of the theoretical model elements, for successful buyer supplier engagement, within the Volvo case. Chapter 5 presents the proposed solution and recommendations for the Volvo case. Finally, Chapter 6 presents the conclusions in response to the purpose of this research and provides recommendations for further research.

2 Introduction to Volvo

In accordance with the process of applied research, whereby the client identifies a problem requiring investigation (Easterby-Smith et al., 1991), VTEC has identified two key issues about which they would like further understanding (see Section 1.1). To build a picture of where, within the Volvo Group, these issues have been raised, this chapter presents some background information about the organisation of the Volvo Group. It also outlines Volvo Group's vision, mission and values, as a basis for understanding the context of the Volvo Group, the CS09 project and the basics of the chemical management service contract in place at Eskilstuna.

2.1 Organisational Background

Volvo group is organised in a matrix fashion consisting of a number of business areas and business units that interact to maximise the efficient use of Group-wide resources and to work closely with customers. Business areas (BAs) are essentially the companies delivering sellable products and services and include Volvo Trucks, Renault Trucks, Mack Trucks, BA Asia, Volvo Buses, Volvo Construction Equipment, Volvo Penta, Volvo Aero and Volvo financial Services. The Volvo group recently acquired Nissan Diesel in Asia. Business units (BUs) are the companies that provide the services necessary for the business areas to deliver products and services. These include Volvo 3P, Volvo Powertrain, Volvo Parts, Volvo Technology, Volvo Logistics, Volvo Information Technology, Volvo Technology Transfer and Volvo Business Services. The interaction of these organisational units can be seen in Figure 2-1 below (note Volvo Technology is one of the 'Other' Business Units):

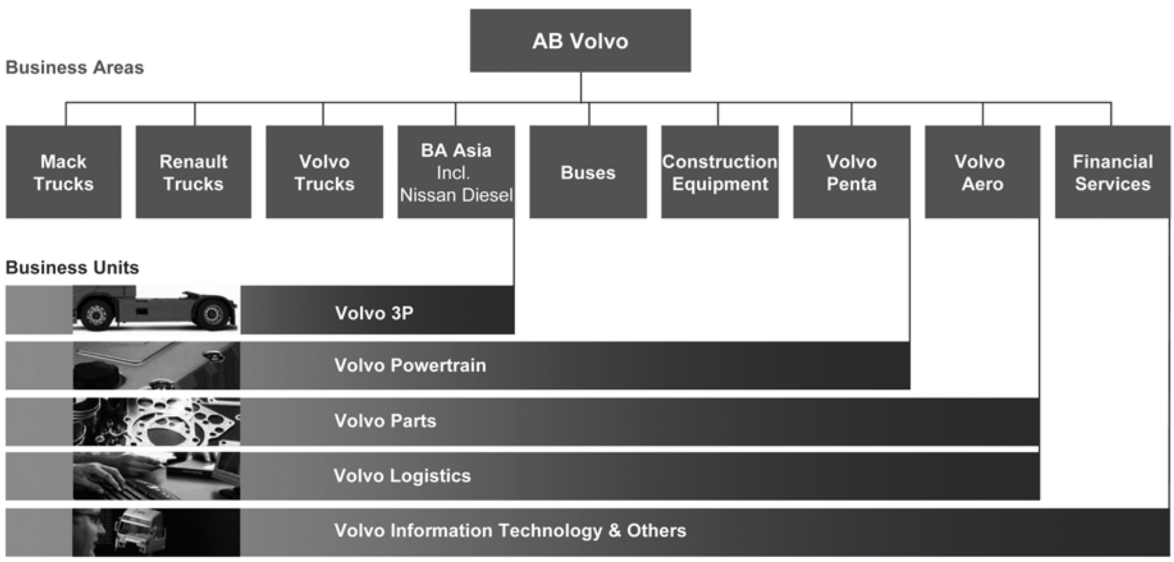


Figure 2-1 Volvo Organisation (Volvo, 2007a).

As can be seen in Figure 2-1, VTEC services all of the BAs within the Volvo Group. VTEC is an innovation company that acts as a consulting service to Volvo Group BAs and BUs as well as to some selected suppliers. This business unit employs approximately 380 people in a number of strategic disciplines that focus on delivering inventions, research and development for new product and business concepts (Volvo). Figure 2-2 shows the Key Technology Areas listed on the left, the Key Expert Functions listed across the bottom, and in the centre, Strategic Disciplines. In essence the key technology areas are the work areas where VTEC focuses its efforts by delivering expert functions through different strategic disciplines.

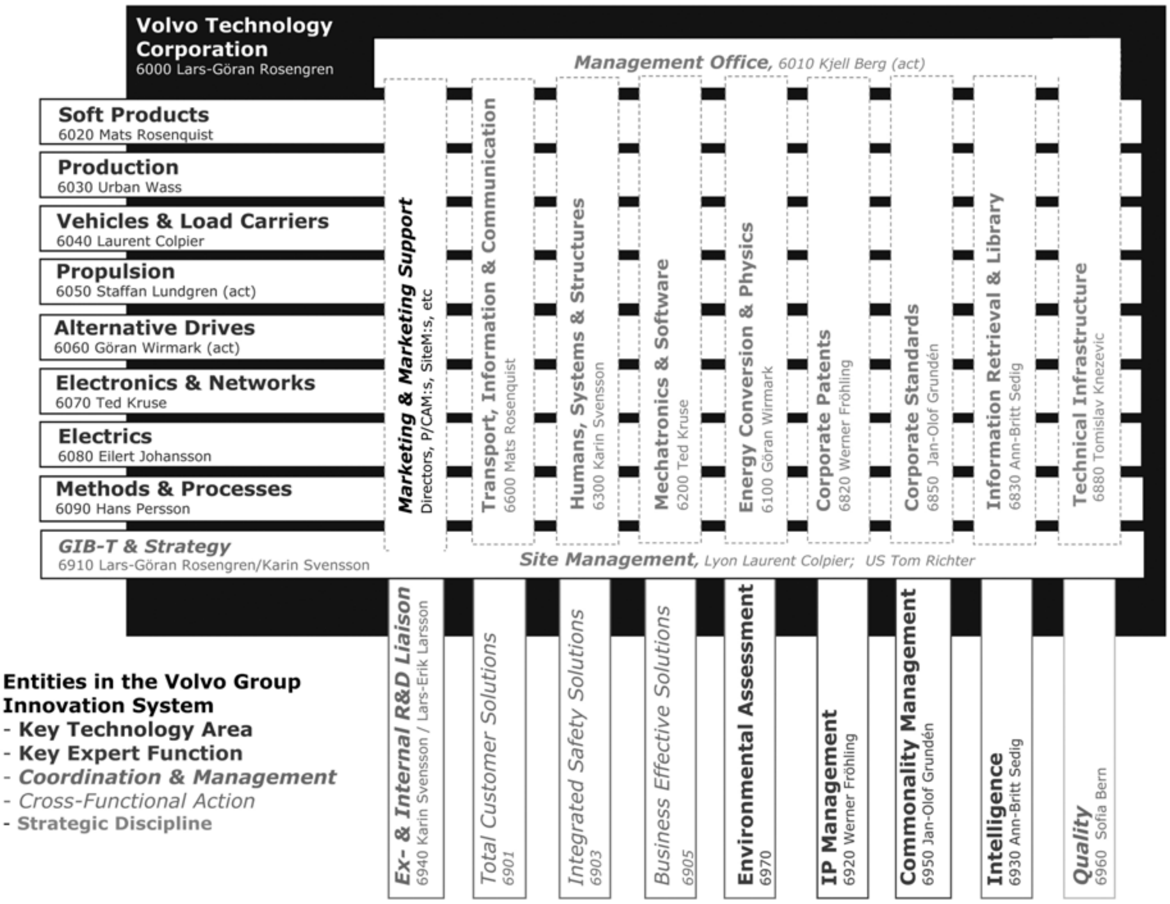


Figure 2-2 Volvo Technology Organisation (Volvo, 2006d).

The discipline of most relevance is Humans, Systems and Structures. This discipline contains a work group called Environment and Chemistry whose primary focus is working on issues relating to all facets of chemical use, within the Volvo Group, and environmental issues. For the production technology area this involves investigating key environmental reporting parameters, minimum requirements for production units as well as development of new technologies for chemical processes and environment technology. Developments relating to the use of CMS systems are influenced by this group as a result of their responsibilities for chemicals. This group helped to initiate the first CMS contract between Eskilstuna and BP Castrol and continues to provide support for contract developments.

Volvo Construction Equipment manufactures and sells products for construction purposes including excavators, articulated haulers, motor graders and other products. In addition to the sale of these products VCE also sells spare parts, used equipment and refurbished parts and equipment, provides financial services, maintenance agreements and the opportunity to rent equipment. In 2006 VCE contributed 40.6 billion SEK (approx. €4.4 billion) in net sales amounting to 16% of Volvo Group's net sales (Volvo, 2006b). According to Volvo the market conditions for construction equipment were favourable for growth in 2006 (Volvo, 2006b). In line with this continued growth and the growth of previous years VCE is now committed to an expansion of its Eskilstuna production facility.

It is important to understand where, in the organisational structure, the research issues have originated. Eskilstuna falls under the operations of the Component Division as indicated in Figure 2-3 below.

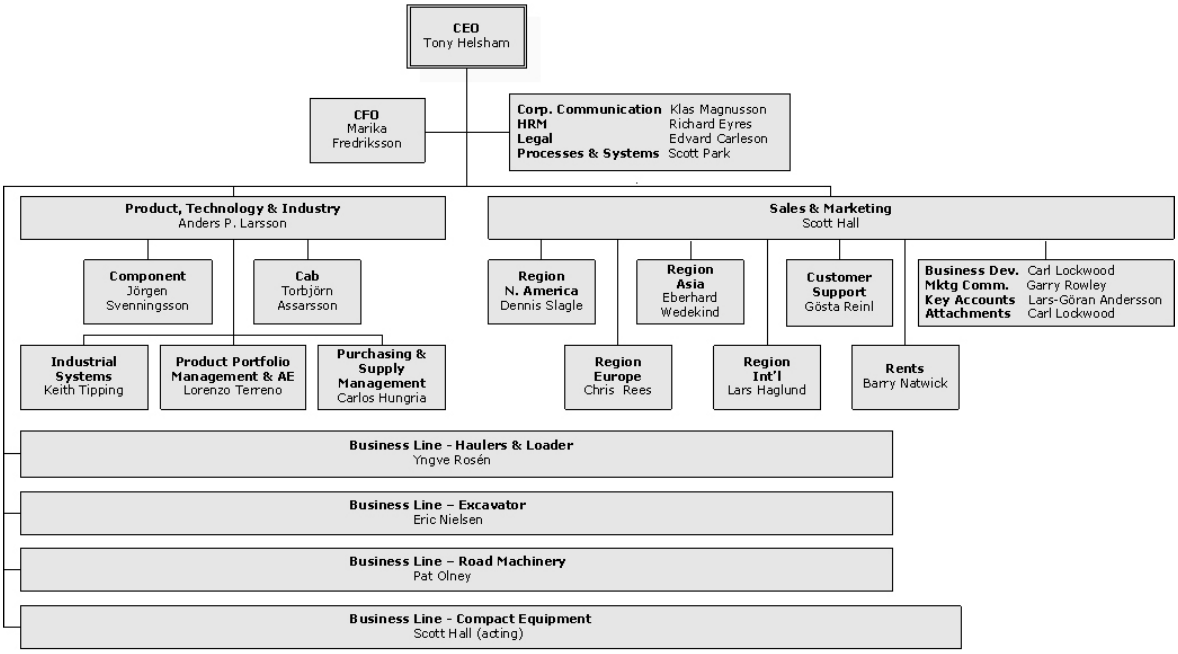


Figure 2-3 Volvo Construction Equipment Organisation

The structure of the Component Division is further elaborated below in Figure 2-4. It is important to note that the Production manager within this hierarchy is the owner of the CMS contract for Eskilstuna. Although, this individual has final responsibility, the work conducted within the CMS contract is delegated down the hierarchy.

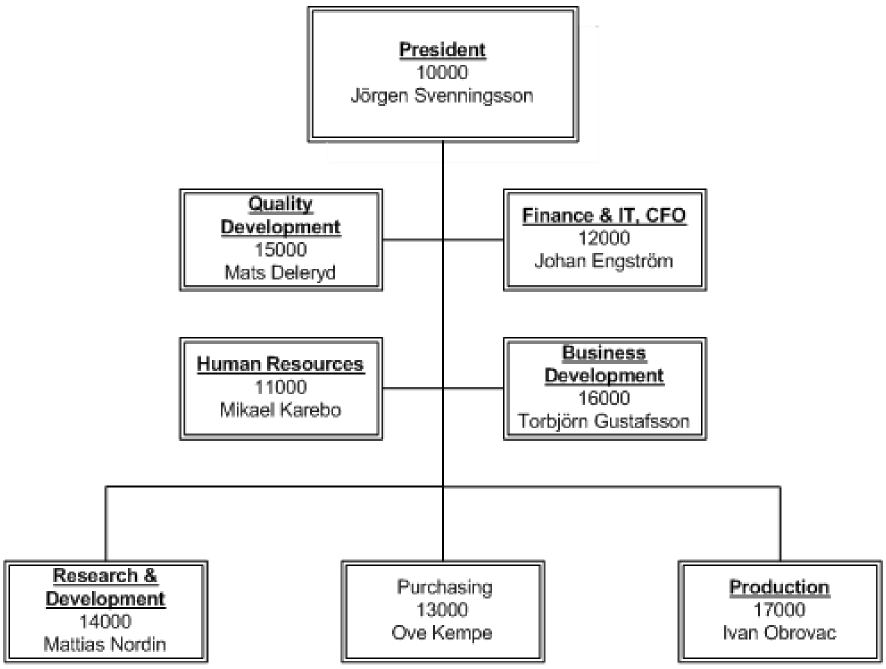


Figure 2-4 VCE Component Division

Within the Component Division, Quality Development (Kvalitestutveckling) is broken down into a series of groups. One of these groups, Management Systems and Methods Development (Ledningssystem och Metodutveckling) is of particular interest (Figure 2-5).

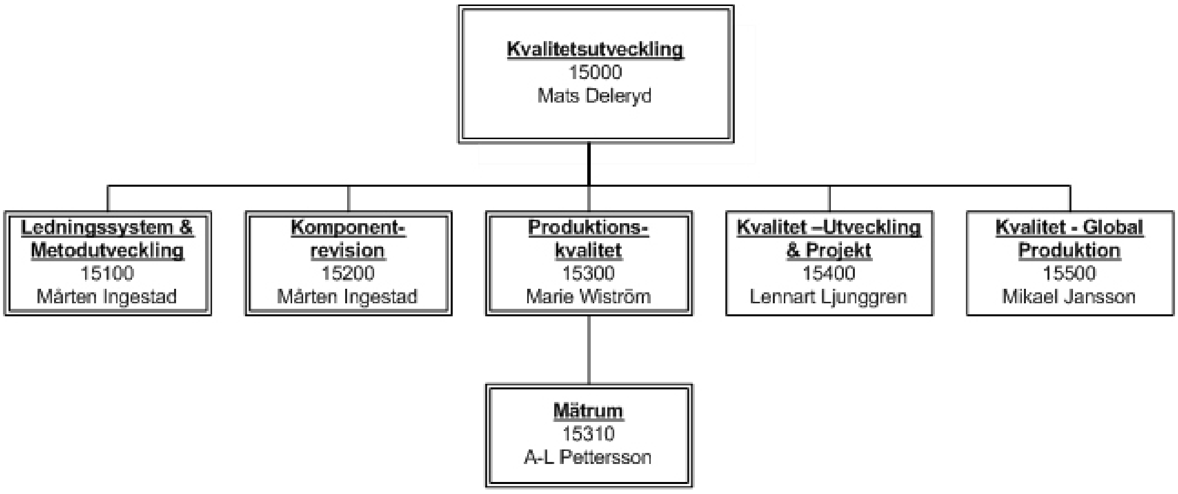


Figure 2-5 VCE Component, Quality Development

It is within this group that the environmental management system is administered at Eskilstuna. This work is conducted by the environmental coordinator (See 'Miljö' Figure 2-6). The environmental coordinator is also responsible for reporting issues relating to the CMS contract from the shop floor to the CMS Board. In addition, this individual also conducts most of the work necessary in administering the CMS contract between VCE CMP and BP Castrol.

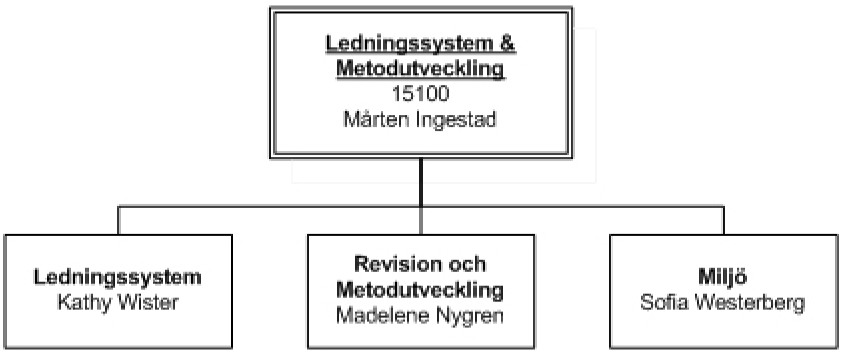


Figure 2-6 VCE Component, Quality Development, Management Systems and Methods Development

It should be noted that the organisational structures for the Volvo Group are very large and somewhat complicated in nature. It suffices to understand the key organisational positions described above.

To summarise, the organisational elements studied in this research include AB Volvo, Volvo Construction Equipment's Component Division at Eskilstuna, Volvo Technology, Volvo Non-Automotive Purchasing and BP Castrol.

2.2 Volvo Vision, Mission and Values

Volvo Group's vision is to be the world's leading supplier of commercial transport solution (Volvo, 2006b).

Volvo Group's mission is to create value for its shareholders by creating value for its customers (Volvo, 2006b). They do this by using their expertise to create transport related products and services of superior quality, safety and environmental care for demanding customers in selected segments (Volvo, 2006b). Volvo Group works with energy, passion and respect for the individual (Volvo, 2006b).

Volvo Group's corporate values are quality, safety and environmental care and form the basis of all Volvo Group activities. By applying and strengthening these values the group can achieve their vision and can maintain a leading position in these areas (Volvo, 2006b)

These core values are implemented in the Volvo Group with a reference point being The Volvo Way document (Volvo, 2004c). This document is compulsory reading for all employees and establishes what it means to work with Volvo Group. This document sets out the vision, mission and values and elaborates on what it means to be Volvo. Another important aspect of this document is the 'wanted position'. It is made up of three key elements (Volvo, 2004c):

- Number one in image and customer satisfaction.
- Sustainable profitability above average.
- Number one or two in size or superior growth rate.

These elements are the goals towards which every Volvo Group employee should direct their work efforts. It is, therefore, useful to reflect on the problem in light of how it relates to, or can be approached, with respect to this wanted position.

2.3 Component System 2009 (CS09)

Eskilstuna will double its production capacity by the end of 2009. This expansion project, CS09, has been in planning for a number of years and is the project within which radical changes to the chemical handling/management system could occur. At the same time, this project aroused interest in the continuous improvement of the chemical handling/management system studied here.

CS09 has been conducted on the basis of a project model that is somewhat in line with the global development process (GDP - see Section 4.2.8). Like the GDP process, the work model consists of a number of phases of work and a series of gates, where money is released to proceed with the project. After completion of this project, this project model will become a Volvo standard, indicating the expected level of effectiveness of this model - expected because this project is not yet complete and how well this project has been completed, along with its results, will not be know until some time after 2009.

It must be stated that one of the purposes of the CS09 method is as a decision making model, based on economic viability, to build robust systems. The model is built around a ten year Masterplan that estimates how much production Eskilstuna will need to conduct over that period of time. Policies appear to be of little importance in this model since its focus is solely upon achieving the required production volumes at the lowest possible cost.

While the Masterplan forms the basis of decision making within CS09, the context for those decisions is established through AB Volvos core values; environment, quality and safety.

2.4 Eskilstuna's Chemical Management Service

For clarification, BP Castrol is contracted to VCE Component Division, Eskilstuna, to provide the following products and services in return for remuneration per unit or per hour:

- Products:
  - All cutting fluids (including emulsions, oils and soluble metalworking fluids),
  - All cleaners (for parts washing),
  - Floor cleaners,
- Services:
  - Procurement of fluids,
  - Monitoring and maintenance of fluids (including provision of additives),
  - Disposal of waste fluids,
  - Information regarding chemical usage and problems reported back to Volvo,
  - Working closely with Volvo to solve problems.

2.5 Volvo's Approaches to Continuously Improving and Sustainably Developing Manufacturing

As discussed in the Methodology Section (1.7.1) a review of literature was conducted after empirical data gathering to better define the scope of investigation. Initial discussions revealed that Volvo applied a number of approaches to continuously improving and sustainably developing manufacturing as discussed in literature. Table 2-1 outlines the application of these approaches within the Volvo Group's actors and systems.

Table 2-1 Volvo approaches to continuously improving and sustainably developing manufacturing

Approaches to Continuously Improving and Sustainably Developing Manufacturing	Application at Volvo
Sustainable development principles	Not currently – no sustainability goals exist
Kaizen	Yes – at the core of the VPS
Six Sigma	Yes – an element of the VPS
Lean Manufacturing	Yes – the basis of the VPS
Total Productive Maintenance	Yes – elements are contained in the VPS
ISO 14001 Environmental Management System	Yes – Eskilstuna and BP Castrol are both certified
Integrated ISO 14001, ISO 9001 and OHSAS 18001 Systems	Yes – new Business Management System (BMS) integrates ISO 14001 and ISO 9001 systems. OHSAS 18001 not used

Integrating ISO 14001 and Lean Production	Not currently – VPS is still in development
CMS as a PSS	Yes – VCE purchases CMSs from BP Castrol
Supplier Integration	Yes – joint problem solving exists to a limited extent between VCE CMP and BP Castrol
Supplier Development	Yes – limited to placing demands on suppliers such as through environmental requirements for suppliers. Currently not a proactive approach
Operational Knowledge Transfer Activity	Yes – BP Castrol personnel work on-site with VCE CMP personnel
Buyer-Supplier Closeness	Yes – interviewees used this term to classify the relationship between VCE CMP and BP Castrol
Technological Innovation and Integration	VCE CMP are trying to pursue this idea.

The information in Table 2-1 formed the foundation for further investigation of the literature on each of the research areas relating to approaches for continuously improving and sustainably developing manufacturing. Review of these approaches is presented in the next chapter.

3 Business Approaches to Continuously Improving and Sustainably Developing Manufacturing

This chapter outlines a number of key research fields related to the issues identified in Section 1.1. It begins with a general introduction to sustainable development and sustainable business and then introduces approaches to continuous improvement, chemical management services (CMS) as a product service systems (PSS), environmental management systems (ISO 14001), integrated management systems and buyer-supplier relationships. Finally a summary of key findings is presented in a theoretical model for successful continuous improvement work between a buyer and supplier when a service provision contract is in place.

3.1 Understanding Sustainability

Initial discussions with VTEC revealed that when referring to the continuous improvement of the company, there were intermittent references to 'sustainable development.' In some cases the term continuous improvement was used interchangeably with sustainable development prompting an investigation into how sustainable development is defined and how it might relate to the Volvo case of continuous improvement. 'Sustainable development' is a term often used and frequently misunderstood by companies. If Volvo wishes to work towards sustainable development, it is first necessary to understand what this term means in general and then in the context of business.

'Sustainable development' originated in 1987 with the release of the World Commission on Environment and Development's *Our Common Future,* more commonly known as the Brundtland Report. The report defines sustainable development as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (Brundtland, 1987). Of course, this definition was intended for the context of the development of nations and the world as a whole, not for the development of companies. However, by taking a look at some of the strategies presented by the report, targeted at national policy making, a very broad picture of the goal of sustainable development can be seen.

The report outlines a number of key strategies for world development. Four of the seven strategies could be applied to the context of industry and business. It is important to keep in mind that these strategies are intended for bringing the worlds poorest out of poverty and to promote harmony between humans, themselves and nature (Brundtland, 1987). However, it does not hurt to consider these very core principles for development. The four applicable strategies are (Brundtland, 1987):

- *Changing the quality of growth:* such that growth can continue in a way that reduces material and energy intensity and reduces vulnerability,

- *Conserving and enhancing the resource base:* to curb the rate of consumption (or over consumption) such that Earth's natural resources are conserved and enhanced,

- *Reorienting technology and managing risk:* such that technology development pays greater attention to environmental factors, and,

- *Merging environment and economics in decision making:* to reinforce the intersectoral connections between economics and ecology.

It is quite understandable that these strategies present a rather bleak picture for those in industry. In order to reach these goals industries have to change the way they make their money, such that their traditional mode of selling as much as possible, is eliminated. While this presents significant challenges for companies, business models such as that of product service systems present a very successful solution.

In order to achieve such strategic goals a number of requirements should be met, including a political system that ensures participation in decision making, an economic system that is self-reliant in generating surplus and technical knowledge, a production system that preserves ecology, a technological system that continuously searches for new solutions, an administrative system that can self-correct and is flexible, among others (Brundtland, 1987). Business managers must understand that their organisations can play a role in achieving these goals. How they do that is up to them.

It is widely accepted that businesses now have an opportunity to prosper from the opportunities presented by working to achieve such (seemingly) lofty ideals of sustainable development. For example, many are familiar with the case of the carpet tile manufacturer Interface Inc. Ray Anderson, with the help of the entire Interface workforce, turned this company from a fossil fuel guzzling production machine into an environmentally conscious success story and the numbers back up the financial success. Through the implementation of programs, such as QUEST (Quality Utilizing Employee Suggestions and Teamwork), the companies 40% reduction of total waste managed to save US$67 million (approx. €48 million) in the three and a half years following 1995 (Anderson, 1998). More recent figures show that the cumulative avoided costs for waste elimination activities totalled US$336 million (approx. €243 million) from 1995-2006 ("Interface Sustainability: Global Metrics,"). In the period 1996-2006 the volume of manufacturing waste sent to landfill decreased by 70% and water intake at modular carpet facilities decreased 80% ("Interface Sustainability: Global Metrics,"). In the meantime, from 2003-2006 Interfaces net sales continued to increase from US$766 (approx. €563 million) to US$1 075 million (approx. €790 million) ("Interface Annual Report," 2006). It is clear that the measures taken at Interface did not 'cost' them at all.

But, it is not clear how a company should adopt the principles for sustainable development into their own strategies or how they should implement the activities necessary to achieve the goals established through those strategies. Anderson (1998, p. 7) asserts, and this is one of the rationales for this research (although it is acknowledged that much has been done since the release of his work):

> *There is not an industrial company on earth, and – I feel pretty safe in saying – not a company or institution of any kind…that is sustainable, in the sense of meeting its current needs without, in some measure, depriving future generations of the means of meeting their needs.*

Anderson clearly acknowledges the principles established by the Brundtland report. Bob Willard, author of *The Sustainability Advantage,* doesn't go quite that far but suggests that most businesses are 'squandering' the benefits of adopting sustainable development strategies (Willard, 2002). Sarkis, (2001), too states, in the opening line of *Greener Manufacturing and Operations,* that the corporate sector has the greatest opportunity to make a positive impact on society's dealings with the environment. In addition, the myriad of books and scientific articles, on the topic of sustainable business practice, clearly demonstrate the growing belief; that businesses can work towards sustainable development.

The Natural Step, ISO 14001, Factor X, Ecological Footprinting and Life Cycle Assessment are some of the major tools that have emerged for the management and measurement of sustainable development and these have all gained worldwide acceptance (Robert et al., 2002). Other approaches include Design for Environment (DfE), Eco-Efficiency, Zero Waste and Cradle to Cradle design. To gain an insight into some the ways in which these approaches are applied it is necessary to look at each one in some detail. Of particular importance here are The Natural Step and ISO 14001 Environmental Management Systems (EMS). Three more areas of importance are added; approaches to continuous improvement, Product Service Systems (of which one example is chemical management services) and buyer-supplier relationships - as approaches specifically related to the case at hand.

3.2 Progress of Sustainable Development

Nattrass and Altomare (1999, p. 16) point out that there have been four stages in the evolution of sustainable development occurring roughly during the decades of the 1970's, 80's, 90's and today. Figure 3-1 shows these stages and highlights the key approaches of these time periods.

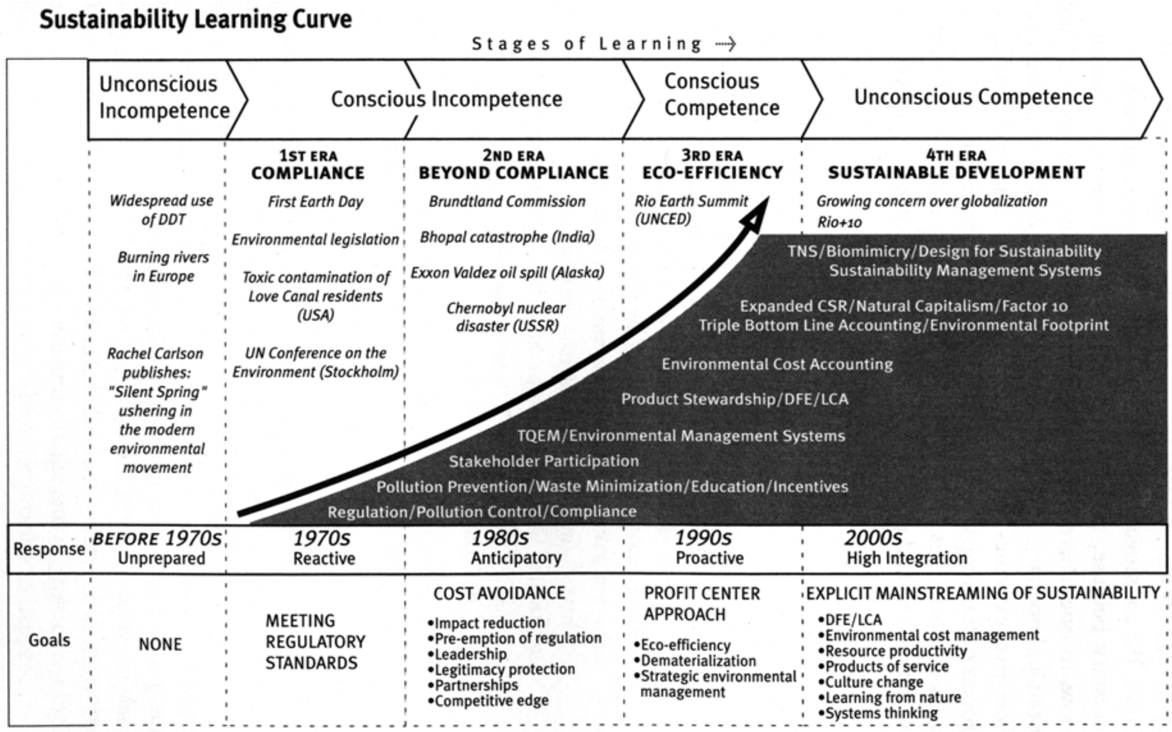


Figure 3-1 The evolution of sustainable development (Nattrass & Altomare, 2002, p. 41)

The earlier approaches of pollution control, pollution prevention and stakeholder participation – the first, second and third eras of sustainable development in industry - were not considered here. Instead, the focus of literature review was on the strategy of sustainable development as presented in the fourth era. Particular attention was paid to the most recent approaches of the fourth era characterised by 'high integration.'

In 1998 Carl Frankel, in an attempt to characterise this 'fourth era' (as shown in Figure 3-1 – That's NOW!) of corporate environmentalism, suggested four interrelated principles that would make up, or at least contribute to a model of corporate sustainable development. These principles are (Frankel, 1998, pp. 81-84):

1. Rather than trying to reduce waste from production, the goal should be to eliminate it; *zero waste.*

2. The best way to achieve such radical notions as zero waste is not to try to fix or improve the current system, but, to *redesign* industrial processes. In order to do this we must think with a *whole-systems perspective* (known as Systems Thinking).

3. External sustainability is equally important is internal sustainability. That is to say, companies must *look outwards* for the opportunities relating to sustainable development.

4. Altering the focus from “the environment” toward “sustainable development.”

These principles establish a very good starting point for a company’s work towards sustainability. By incorporating these ideas into Volvo Group’s strategies and into daily work, the Volvo Group could also contribute to the efforts of sustainable development, as set out by the Brundtland report. However, while these principles provide a kind of working frame within which work efforts could be directed, they do not provide an endpoint or a goal for development. The Natural Step is one such set of goals that fulfils this role.

3.3 The Natural Step

Since 1988 The Natural Step (TNS), a not-for-profit non-governmental organisation, has worked towards disseminating a shared mental model of principles for sustainable development. The principles, developed by Karl-Henrik Robèrt based on the laws of thermodynamics, are now well known and respected as a result of exposure through such high profile users as Ikea, Electrolux, Nike, Starbucks, Du Pont, McDonald’s, Scandic Hotels, The Home Depot, BP, Interface Inc., Sainsbury’s, Nike, BHP Billiton (QNI Nickel), Woolworths, GlaxoSmithKline and the US Environmental Protection Agency ("The Natural Step International Gateway," 2003). The Natural Step’s vision is a global shift to ecological and social sustainability through assisting organisations to develop strategic sustainability initiatives ("About The Natural Step," 2003).

TNS presents a very broad picture of how a sustainable society will look and could be used by the Volvo Group as the starting point, or more correctly the ending point, of all continuous improvement activities. Perhaps the most well-known aspect of TNS is its first order principles for sustainability, more commonly referred to as the Four System Conditions for sustainability. These are (Nattrass & Altomare, 2002, p. 19):

In the sustainable society, nature is NOT subject to systematically increasing:

1. *…concentrations of substances extracted from the Earth’s crust;*

2. *…concentrations of substances produced by society; or*

3. *…degradation by physical means*

And, in that society

4. *…human needs are met worldwide.*

In essence, what TNS conditions provide is a vision of the goal of sustainability and a "filter" for deciding if actions are heading in the right direction (Frankel, 1998). In an attempt to describe eco-efficiency's goal of making profits within the carrying capacity of the earth, so called eco-capacity, TNS has been suggested as a very good summary of this eco-capacity (DeSimone & Popoff, 1997, p. 55). At the same time, it is suggested, without substantiation, that this framework is viewed by some as too simplistic (DeSimone & Popoff, 1997, p. 55). Irrespective of their perceived simplicity, surely the more simply these conditions can be described, the wider the audience they can reach and the greater results they might achieve. It should also be mentioned that this is a framework that is based in science and is, therefore, not easily disputed.

TNS is a useful model for designing an effective sustainable management system (Stead, Stead, & Starik, 2004, p. 147). The key advantage of this framework is that it promotes a common understanding of ecological principles and their connection to actions. Peter James (in Charter & Tischner, 2001, p. 93) notes that since one of the problems with sustainability is the complexity of issues, mechanisms for creating a feeling of interconnectedness are necessary; TNS is one such framework. Stead et al. (2004, p. 147) also point out that environmental management systems do address the environmental sustainability principles set out in the four system conditions but that the principle of fairness, identified in the fourth principle, is not adequately dealt with.

TNS offers businesses a model of a desirable society to aim for. While these goals may not directly affect the design of individual processes within a large company, such as the Volvo Group, it provides macro level goals towards which the entire organisation can strive.

3.4 Approaches to Continuous Improvement

Although 'continuous improvement' is a term often used in corporate policies, as a way of proclaiming commitment to the never ending search for better ways to do things, the definition of the term is quite blurry. Continuous improvement can most adequately be described as an 'umbrella' term that is used when discussing numerous concepts for achieving improvements in an organisation (Berger, 1997). The following concepts must be briefly described in order to fully understand what approaches to continuous improvement are included under this umbrella: Kaizen, the Japanese birthplace of western society's continuous improvement concept; lean production, a concept for waste minimisation; and Six Sigma, a concept for incremental improvements to processes. In essence, each of these concepts deals with continuous improvement of quality and is sometimes referred to as being part of the quality movement.

3.4.1 Kaizen

Kaizen is considered to be the predecessor of continuous improvement, stemming from the Japanese quality movement (Berger, 1997), and consists of three core principles.

Firstly, kaizen is process-oriented meaning that the focus of continuous improvement is on the process of conducting it rather than on the results that it achieves. Berger (1997) points out that management attention should be directed towards creating sound process and that it is assumed that good results will follow. He elaborates, noting that there are two implications of this; management's role is to support and encourage organisational members to improve processes; and, evaluation criteria, or performance indicators, must be used to assess the improvement process as well as the results (Berger, 1997). It is also of vital importance to completely understand the process that one is trying to improve. Specifically, the variability and interdependence of activities and methods for combining people, machines, materials and information must be comprehensively understood (Berger, 1997).

Secondly, kaizen focuses on ongoing efforts to make small improvements to work standards (Berger, 1997). These small improvements can be coupled with drastic changes, such as technological or other forms of innovation, to maintain and improve performance. One of the cornerstones of kaizen is that an organisation should maintain standard operating procedures for all major operations in order to maintain discipline, enhance learning and distribute responsibility (Berger, 1997). There is also a link between kaizen and the familiar plan-do-check-act (PDCA) cycle. This is used to signify the never ending nature of improvement work that characterises kaizen philosophy.

Finally, kaizen is people oriented meaning that it requires that all people in an organisation are involved with the process of continuous improvement. According to Berger (1997) there are three main kaizen activities:

1. Management-oriented kaizen: deals with gradual improvement of processes, organisation, decision-making, machinery and equipment. The author suggests that chemical handling/management infrastructure could fall under the category of machinery and equipment

2. Group-oriented kaizen: deals with improving work methods, routines and procedures and is carried out by small groups sometimes referred to as 'quality control circles.' In this form, groups are a permanent part of the organisational structure, integrated, and working in a PDCA manner.

3. Individual-oriented kaizen: as the name suggests, deals with individuals working to improve their own work tasks.

Manos (2007), a senior member and instructor of the American Quality Societies Lean Enterprise and Kaizen course, points out that there is a fourth type of kaizen activity; the "kaizen event." It differs from the aforementioned kaizen activities in that it is conducted over a relatively short period of time, about three to five days, and results in big improvements. While this action is still based in the team environment it is, due to its short lifetime, possible to improve the attitude of individuals towards more team oriented work in the future (Manos, 2007). Manos (2007) also notes that a key advantage is that by establishing a set time, in which to conduct a kaizen event, a proactive approach is established to conduct improvement work.

Depending on which type of kaizen activity is being undertaken, and whether or not the activity is running in "parallel" to daily activities or is integral to daily activities, there are five organisational designs. These are; quality control circles; wide focus CI; organic CI; expert task force CI; and individual CI (Bhuiyan & Baghel, 2005). Each of these designs has distinct purposes and merits, however, given the context of a facility upgrade and the possibility this raises with regards to upgrading the chemical handling/management system, the expert task force is most interesting. An expert task force typically consists of professionals from quality, engineering and maintenance operating in a temporary manner (Bhuiyan & Baghel, 2005). Due to the specialised and technical nature of chemical infrastructure upgrade, and the fact that it is a radical change situation, the expert task force provides the greatest chance of achieving continuous improvement. On the other hand, continuous improvement of the chemical handling/management system is more suitably dealt with by quality control circles, as described above, as part of a group oriented task.

It should also be mentioned that according to the lean production approach taken in the Volvo Production System, each of the groups mentioned above would be utilised for different purposes. Ultimately, they would all work towards the same goals.

3.4.2 Six Sigma

This business strategy focuses on the company outputs which are most critical to customers and to identify and eliminate the causes of errors and defects in business processes (Antony, 2004). It is a way of measuring quality. Within a Six Sigma scheme a defect is defined as "…anything which could lead to customer dissatisfaction" (Antony, 2004). Six Sigma is essentially a statistical methodology that allows practitioners to identify the number of opportunities within a process that could result in defects (Antony, 2006). The goal of this methodology is to reduce the variability of processes within an organisation's activities and is built on three basic foundations (Antony, 2004):

1. all work occurs in a system of interconnected processes,

2. variation exists in all processes, and,

3. understanding and analysing the variations are key to success.

Six Sigma activities are typically carried out in two ways. The first is called the DMAIC model and consists of defining the goals and customer deliverables (D), measuring current process performance (M), analysing and determining the root causes of defects (A), improving performance by eliminating defects (I) and controlling performance (C) (Simon). The last point is important to ensure that the failure does not occur again in the future. The second is called DMADV and is typically associated with the design and development of products and services (Antony, 2004). This model consists of defining the goals and customer deliverables (D), measuring and determining customer needs and specifications (M), analysing process options (A), designing the process (D) and verifying the design performance (V) (Simon).

In essence, these processes try to answer four questions (Antony, 2006). What is the nature of the process's defects? Why are the defects occurring and how often? What is the impact on the customer? And, how can defects be measured and subsequently controlled? This approach has been considered in the development of the VPS and so is important to keep in mind when considering changes made to the chemical handling/management system at Eskilstuna. The DMAIC and DMADV models could provide a process for conducting continuous improvement work

3.4.3 Lean Manufacturing

This approach to manufacturing aims to eliminate all waste from manufacturing activities and is centred on the notion that a customer does not want to pay for anything that does not contribute to the value of the product or service. In general terms, waste is defined as anything that does not have a direct relationship to the product or service that the customer wants when the customer wants it (USEPA, 2003). Waste is more specifically classified as; defects, including scrap, rework and off-specification products; waiting, including downtime, bottlenecks and process delays; unnecessary steps, including unnecessary process steps; overproduction; movement, unnecessary human movements, unnecessary product movement; inventory, including excess raw materials and finished goods; unused employee creativity and complexity, including too many process steps, parts and time (USEPA, 2003).

In order to eliminate these wastes a number of tools are used to identify sources and take action. However, the intention of lean manufacturing is not as a method or tool but rather a culture. According to Womack (in Quinn, 2005), the man responsible for bringing the successful Japanese production system to the West, lean is not about achieving a goal, it is about a journey. He also points out that lean should be considered a form of process-focused management where long-term commitment, that is a change in culture, can lead to sustainable success (in Quinn, 2005). These cultural changes can be characterised as focusing on continual improvement on eliminating waste, employee involvement, focus on operations, a performance indicator or metric driven setting, supply chain investment and a whole systems perspective (USEPA, 2003). At least part of the emphasis is being placed on a systems perspective which acknowledges the complexity of the systems in which improvements are usually made.

Lean manufacturing deals with this inherent complexity by starting from the assertion that all value is the result of a process, similar to Six Sigma's assumption. From this point it can be reasoned that the actions, when carried out in the correct order, in the correct way and at the correct time, create value for a customer (Womack in Quinn, 2005). In a manner similar to backcasting, managers can then identify what the customer really wants, can build a complete picture of what is currently occurring to achieve that goal, can identify the wastes that can be eliminated and can then take action to bring the activities closer to the needs of the customer.

One of the key tools used by lean practitioners is value stream mapping. This tool is used to visually map out the actions and material and information flows from raw material input to product delivery at the end of the line. This tool benchmarks the current state of operation such that sources of waste can be identified and eliminated.

Besides this tool, there are about eight methods that can be associated with lean manufacturing. A US EPA report, *Lean Manufacturing and the Environment* (2003), suggests that the following methods are typically conducted in the order presented and that there are varying degrees of interrelations and integration. The methods are:

1. Kaizen
2. 5S – a system of workplace organisation and cleanliness
3. Total Productive Maintenance
4. Cellular manufacturing/Flow production systems
5. Just in Time (JIT) production
6. Six Sigma
7. Pre-production planning
8. Lean enterprise supplier networks

It is evident from this list that Kaizen and Six Sigma are viewed as part of the process of lean production confirming that these approaches to continuous improvement are not isolated but rather, they are a part of a wider approach to improving value adding processes. Volvo Group's VPS contains aspects of all of these approaches.

3.4.4 Total Productive Maintenance

Total productive maintenance (TPM) is relevant for further discussion because its goal is to maximise the effectiveness of production equipment. The recent literature is authored typically by practitioners in industry, consultants and company personnel, and the academic contribution is mainly in the form of case studies. This suggests that the TPM movement may have lost some momentum with the more recent success of the aforementioned approaches. In addition, this can be argued from the perspective that many of the principles that make up TPM could, and have been, incorporated into lean manufacturing systems. For example, the USEPA (2003) notes that TPM is just one of eight methods that make up a lean system.

TPMs ultimate goal is to raise overall equipment effectiveness (OEE) (Thun, 2006) and is defined by Nakajima (in Lycke, 2003) as, 'productive maintenance carried out by all employees through small group activities.' Based on the 5S system, it is not clear how many pillars for success make up TPM. Some authors (such as Brar, 2006) suggest that there are eight pillars but others suggest there are five (Thun, 2006); elimination of waste (see Section 3.4.3), scheduled maintenance, autonomous maintenance, training of machine operators and maintenance prevention. Despite the differences regarding the number of pillars, the final pillar, maintenance prevention, is present in both descriptions. The essence of this pillar is that machines should be designed in a way that results in the need to *not* conduct maintenance on them. It is this point that is most applicable to the case at hand due to the fact that there is now a possibility to conduct design activities that could create a chemical handling/management system that prevents the need for maintenance. Emphasis should also be placed on involving all employees in group work towards such goals.

One important characteristic of TPM is that it is based on the idea that all personnel in an organisation should participate in equipment improvements (Lycke, 2003). In fact, this approach challenges the existing notion; that maintenance is the realm of machine support personnel and contractors, and places the responsibility of equipment maintenance in the hands of the operator. By doing this, those who are most familiar with the equipment are able to work effectively to prevent it from breaking down (Brar, 2006). TPM is typically carried out by small teams that must include operators but can incorporate members from all levels of an organisation (Brar, 2006; Lycke, 2003). In this respect it is quite similar to the organisation required for kaizen activities. It could be argued that, according to this approach, team work is the best form of organisation for continuous improvement.

3.5 Management Systems

According to Vachon and Klassen (2007), environmental management systems are infrastructural investments that improve the way that environmental issues are managed. A review of the ISO 14001:2004 standard for Environmental management systems – Requirements with guidance for use, was conducted to identify any references to continuous improvement or to the applicability of the EMS to any person working for or on behalf of an organisation and to identify the presence of that element in the Volvo case (see Table 3-1). References to continuous improvement are obviously important due to the fact that the improvement of the chemical handling/management system is classified in this way. References to persons working for or on behalf of the organisation are relevant because it is necessary to understand how the actions of BP Castrol personnel, operating within the CMS contract, are affected by Eskilstuna's EMS. The following references are of importance ("Australia/New Zealand Standard: Environmental management systems - Requirements with guidance for use," 2004):

Table 3-1 Application of ISO 14001:2004 at VCE CMP

ISO 14001:2004 Element	Presence in the Volvo Case
4.1 The organization shall define and document the scope of its environmental management system.	Yes.
4.2 b) Top management shall define the organizations environmental policy and ensure that, within the defined scope of its environmental management system…includes a commitment to continual improvement…	Yes. Environmental Policy forms one of the three core values of the organisation. Policy includes a commitment to continual improvement. (see Section 4.2.2)
4.3.1 a) The organization shall establish, implement and maintain a procedure(s) to identify the environmental aspects of its activities, products and services…taking into account planned or new developments, or new or modified activities, products and services,	Not clear. According to the environmental requirements for production facilities all process developments must take into consideration environmental considerations. (see Section 4.2.12)
4.3.3 The objectives and targets shall be measurable, where practicable, and consistent with the environmental policy, including the commitments to…continual improvement.	Yes. The environmental policy establishes that continuous improvement must focus on formulating, communicating and monitoring clearly defined goals. (see Appendix II) The CMS contract contains a number of key performance indicators – not studied here.
4.4.2 …any person(s) performing task for it [the organization] or on its behalf that have the potential to cause a significant environmental impact(s)…are competent…	Yes. The environmental requirements placed on suppliers ensure a certain level of environmental competence. BP Castrol's actions on site are covered under BP Castrol's ISO 14001:2004 certification. Their actions are the liability of Eskilstuna, thus ensuring their competence.
4.4.6 c) The organization shall identify and plan those operations that are associated with the identified significant aspects…by: establishing, implementing and maintaining procedures related to the identified significant environmental aspects of goods and services used by the organization and communicating applicable requirements to suppliers, including subcontractors.	Yes. Environmental requirements for suppliers (distributed by NAP) ensure these criteria are met. (see Section 4.2.13)

A certified environmental management system must include the elements listed above. Since Eskilstuna is certified, it is assumed that their system adequately deals with these elements.

3.5.1 Integrating ISO 14001, ISO9001 and OHSAS 18001

According to Jørgensen, Remmen and Mellado (2006) there are four levels of management system integration ranging from relatively simple, corresponding systems through to coordinated systems, coherent systems and, at the most advanced level, strategic and inherent systems. At the most advanced level the idea is to create a new culture within an organisation that encourages learning, stakeholder participation and, most importantly, continuous improvement (Jørgensen et al., 2006).

For some time now researchers have discussed the ways in which different management systems for quality, the environment and health and safety can be integrated. The International Standardisation Organisation also acknowledges that integration of systems can be beneficial pointing to the similarities between the management systems for quality and the environment ("Australia/New Zealand Standard: Environmental management systems - Requirements with guidance for use," 2004; "Australia/New Zealand Standard: Quality Management Systems - Requirements," 2000). Indeed, one of the major changes made in ISO 14001:2004 was to improve its coherency with ISO 9001:2000 (Jørgensen et al., 2006). In addition to this change, in 2002 a common standard for quality and environmental auditing (ISO 19011:2002) was released highlighting the ISO's attempt to integrate the systems. At the centre of this integration is a clear focus on the PDCA cycle. Jørgensen et al. (2006) confirm that it is necessary to have a very thorough understanding of this cycle pointing out that each system has requirements for continuous improvement based on the PDCA cycle.

It should be made clear that one of the reasons that companies might choose to integrate such systems is to reduce administrative costs by improving internal coordination, gaining competitive advantage and working towards corporate responsibility and sustainable development (Jørgensen et al., 2006). At the same time, an integrated management system can also be viewed as a strategic and inherent way to achieve 'real' continuous improvement, defined by Jørgensen et al. (2006) as contributing to sustainable development. For this reason it is necessary to understand sustainable development as outlined in Sections 3.1 - 3.3.

At the centre of continuous improvement, as discussed in kaizen, six sigma and lean production, is the necessity to involve every employee in the process. It will be seen that this perspective is also held by the Volvo Group and is applied through the Volvo Production System. Hines, (in Jørgensen et al., 2006) confirms that indeed, the input of all is of the utmost importance.

3.5.2 ISO 14001 and Lean Production

The development of lean production systems inevitably requires some consideration of environmental issues. In essence, lean production aims to eliminate waste, classified broadly as anything that does *not* contribute to adding value for the customer. At the same time EMSs, specifically ISO 14001:2004, attempt to eliminate many forms of waste including air, water and solid waste emissions. While their perspectives are different, with lean looking to improve the value to the customer and EMSs looking to reduce environmental impacts, both approaches aim to eliminate wastes of various forms. Tice, Ahouse and Larson (2005) believe that there is an opportunity for lean production systems and EMSs to be compatible for mutually beneficial outcomes.

According to Tice et al. (2005) there are a number of specific benefits provided to an EMS by lean production systems:

- Since a lean production system is typically driven by strong financial incentives, such a system can improve the effectiveness of an EMS by linking it into stronger financial drivers.

- The methods for conducting continuous improvement, provided by lean production systems, can support effective EMS implementation.

- Since lean production systems focus on involving all personnel, there is a possibility to better incorporate the roles and responsibilities of EMS personnel through the entire organisation.
- Lean production systems can help to improve the performance of the EMS by eliminating non value added activities conducted within that system.
- Kaizen events can be used to conduct rapid improvements to specific environmental objectives.

At the same time, they also point out the advantages provided to a lean production system by an EMS (Tice et al., 2005):

- An EMS widens the definition of waste, adding air and water emission and solid waste.
- An effective EMS proactively addresses upcoming regulatory compliance issues regarding environmental compliance driving lean production improvements.
- With a focus on life-cycle perspective, an EMS can widen the perspective of a lean production system.
- Since lean production does not use material substitution - only reduction and elimination, an EMS can be used to switch to less harmful product and material alternatives

Although there may be clear advantages in building cooperation between lean production and environmental management systems, there is a tendency for the two systems to operate in parallel using different tools and processes to achieve similar goals (Tice et al., 2005). With this in mind it is important that personnel within both systems are made aware of the benefits of the other. While EMSs are a management framework, lean production provides practical tools for eliminating waste, thus creating a possibility for cooperation. There is a risk that the standard operating procedures common to EMSs may be unable to keep up to date with the rapid changes characteristic of lean production (Tice et al., 2005).

One very specific advantage of integrating lean and EMSs is the possibility to use value stream mapping, fundamental to lean and part of the VPS, in conjunction with the identification of significant environmental impacts. According to Tice et al. (2005), by combining value stream mapping with the identification of environmental impacts, an organisation can gain a more holistic view of its processes and performance. By doing this, organisations can identify opportunities for process improvements.

3.6 Product Service Systems

A small but growing bank of work exists on chemical management services (CMSs). Most of this work relates more generally to product-service systems (PSSs). However, CMSs are one application of a PSS whereby instead of selling a chemical product, the supplier sells expertise and the function of chemical products.

Before taking a look at chemical management services, it is first helpful to understand the concept of product-service systems. A PSS is a system that changes the focus of business from designing and selling physical products only, to selling a system of products and services that fulfil a clients demands (Manzini & Vezzoli). Mont (2002) clarifies this definition as "a system of products, services, supporting networks and infrastructure that is designed to be: competitive, satisfy customer needs and have a lower environmental impact than traditional business models." In essence, a PSS aims to compete, through generating value for customers while, at the same time, decreasing total resource consumption. It achieves this goal through a change in the relationships between stakeholders such that concomitant systemic resource optimisation is achieved (Manzini & Vezzoli).

According to Mont (2002), a PSS contains (see Figure 3-2) products or services, or a combination of both as a means of fulfilling some need. Also included are services related to the sale of products, concepts of product use, classified as use-oriented and result-oriented, maintenance services, with the goal of prolonging product life, and revalorisation services involving product take back, reuse and recycling. Of particular importance are the classifications given to the different approaches to the user phase. Use-oriented systems focus on a product's service "…where product utility is extracted by the user" whereas result-oriented systems allow the service provider to extract the utility of the product on behalf of the user (Mont, 2002). The latter is the type of PSS in place between BP Castrol and VCE CMP.

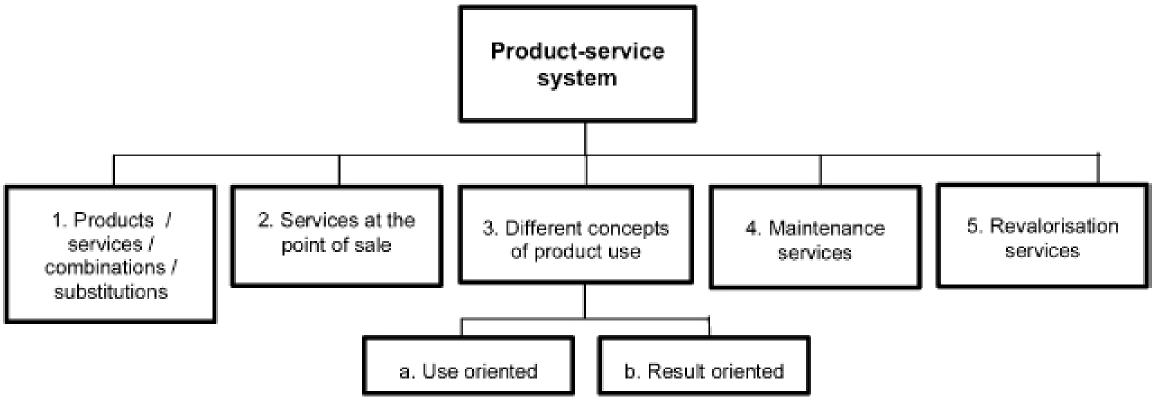


Figure 3-2 Classification of a product-service system (Mont, 2002)

There are three main approaches to PSS that have been identified as presenting the possibility of achieving such goals. These are services providing added value to the product life cycle, final results for customers or enabling platforms for customers (Manzini & Vezzoli). It is the services providing a final result for customers that can be applied to the Volvo case. According to Manzini and Vezzoli (Manzini & Vezzoli) this business strategies focus is to sell a final result and is provided through the provision of a mix of services. The producer retains ownership of any products used to achieve that final result and is paid according to a unit of service. For example, in the case of a CMS, the producer of the chemical products retains ownership of those products and sells the final result, such as lubrication or degreasing, to the customer per unit of service. The producer is also responsible for delivery, storage, optimisation and disposal of the products after their useful life.

The advantages of operating in such a way include reductions in energy and material consumption since producers' profits depend on how well they achieve the final result. In this case, if the final result were achieved using less energy and materials, the producer would increase their profit. Product life can be extended since the producer will want to get the most use out of every product to minimise consumption and maximise profits. This will lead to higher reliability as the producer will work hard to ensure that products are operating optimally. Extended product life leads to disposal costs being postponed and subsequent replacement product manufacture costs being postponed. In addition, when the product does reach the end of its useful life, the producer will be more likely to invest in recycling or reuse strategies to get the most profit out of every unit of service that can be provided by a product.

For the producer, there are clear incentives to reduce the quantities of energy and materials used to deliver each unit of service. It should be noted that in response to the change from product delivery to service delivery there may be an increase in the costs associated with maintenance, optimisation and end of life strategies (Manzini & Vezzoli). While the customer is freed from the responsibilities related to sourcing, acquiring, using and finally disposing the product, there may be an increased burden when negotiating contracts for the provision of services.

3.6.1 Chemical Management Services

As stated, CMS is one application of a product service system that serves as "…a business model in which a customer engages with a service provider in a strategic, long-term contract to supply and manage the customers' chemicals and related services" (Stoughton & Votta, 2003). The CMS model is based on the assumption that the user of a chemical is less interested in paying for the chemical itself and more interested in paying for the function that that chemical can provide, such as stripping, degreasing, lubricating, cooling and so on. The degree to which such services can be provided varies and is determined largely by contractual agreements between the service provider and client. However, it seems that the greatest potential for mutual financial gains and chemical reductions are achieved when the system is more comprehensive (Stoughton & Votta, 2003). In other words, the more the elements of the system are servicised, the more likely it is that the producer and client will achieve financial gains and chemical reductions.

Total chemical costs and core competency are the principles that underpin CMS theory. Total chemical cost refers to the sometimes invisible costs associated with procurement, delivery, testing, monitoring, reporting, internal logistics and numerous other actions that support the total chemical life cycle. Figure 3-3 highlights these functional elements and Figure 3-4 describes the level of visibility of most of the functions.

These functional elements could assist negotiators when drawing up service provision contracts by acting as a means of dividing responsibilities in a systematic fashion. They also allow for the customer to take into consideration the total cost of the chemical products including all of the functions necessary to support their use in the operations of the company. Stoughton and Votta (2003) point out that chemical management contracts must be based on total chemical costs or they risk doing nothing to alter the incentives in the producer-customer relationship. It is, therefore, critically important that any CMS contract is built on an understanding and division of responsibility for the functions that constitute total chemical costs. This investigation brings this delegation of responsibilities in focus.

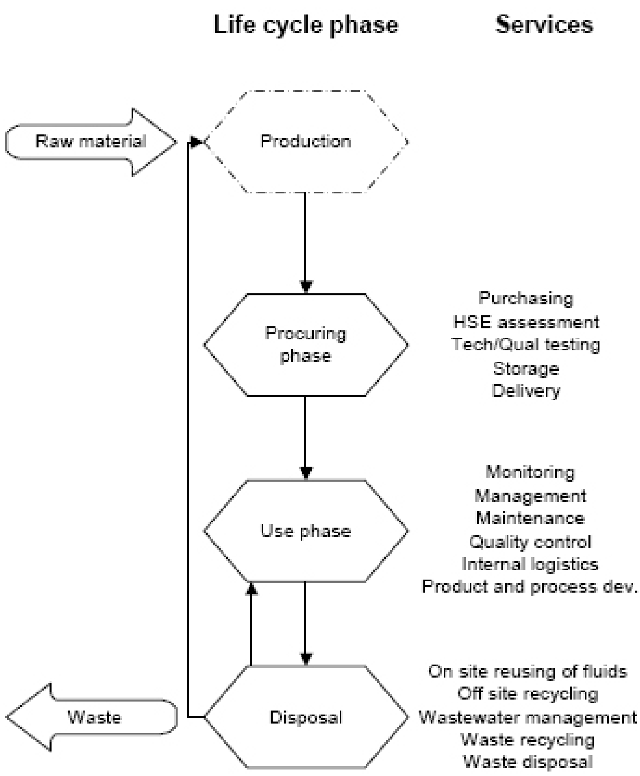


Figure 3-3 A general model of total chemical cost – contributing functions (Kurdve, 2006)

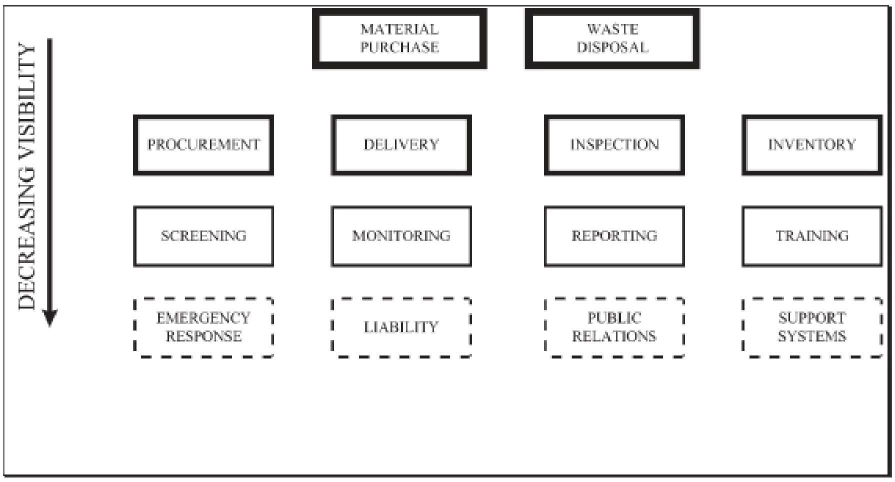


Figure 3-4 Visibility of functions (Stoughton & Votta, 2003)

The core competence of an automotive manufacturer is to produce automotive solutions, not manage chemicals. At the same time, a chemical producer is intimately knowledgeable about their products and, at least in theory, experts in their optimal use. Their core competence is chemicals manufacture and use. For a CMS to be successful, the service provider must be able to provide the services related to chemical management in a more cost effective way than can the automotive manufacturer. In the case where there is very little in-house expertise in conducting the functions outlined in Figure 3-3, a CMS is ideal for enabling the most effective and efficient management of chemicals. By outsourcing the expertise to those who have it, the customer is able to eliminate costs associated with functions that are not part of their core competencies. However, it could also be argued that even when chemical expertise is a core competence there may be advantages in engaging service providers in process and/or product development.

Lack of management focus and lack of internal expertise in chemical management, including process knowledge, tracking, inventory control and chemistry are two reasons that internal chemical management might be failing (Stoughton & Votta, 2003). In this case a manufacturer would be wise to engage a chemical management service provider to relieve them of the burden of competencies which are not their own.

While the benefits of a CMS include reduced chemical consumption, improved efficiency, inventory control, screening procedures and reduced waste, one of the major barriers can be resistance from personnel (Stoughton & Votta, 2003). As with other forms of outsourcing, personnel view the handing over of responsibilities to an outside company as a threat to their jobs and to their own expertise. This has also been the experience of VCE CMP in introducing the current CMS contract.

3.7 Buyer-Supplier Relationships

The field of business to business relationships offers a number of insights into the relational aspects of this case. Supplier integration, supplier development, the concepts of closeness and technological change within the context of relationship management provide valuable knowledge on the nature of buyer-supplier relationships. Each is dealt with separately now. To clarify, for this case VCE CMP at Eskilstuna is the buyer and BP Castrol is the supplier (sometimes also referred to as the service provider).

3.7.1 Supplier Integration

According to Vachon and Klassen (2007) integration of a buyer and supplier occurs as a way of improving the buyer's and/or the supplier's operations. Integration is motivated by the recognition of interdependency between the buyer and supplier and is defined as a state of linking between a supplier, purchasing and manufacturing sections of an organisation (Das, Narasimhan, & Talluri, 2006). One of the key aspects of supplier integration is that within such an operating state there are many mechanisms with which to improve performance. One such mechanism is joint problem solving (Das et al., 2006). This aspect is particularly interesting for this case when considering that the problem centres on the way in which VCE CMP and BP Castrol can work together for continuous improvement. Joint problem solving thus, is a technique that exists within an established way of working – supplier integration.

One particularly interesting aspect put forward by Das et al. (2006) is the concept of internal supplier integration. The example provided outlines the way in which the purchasing and manufacturing departments work together for joint goal setting, participation in cross functional teams and participation in new process development activities (Das et al., 2006). This allows for a number of questions to be asked of the Volvo case; to what extent does this integration occur? If it exists can it be harnessed for the enhancement of continuous improvement activities?

3.7.2 Supplier Development

While the questions of internal integration are critically important for ensuring successful continuous improvement, the notion of supplier development offers another method for improving a buyer's performance. According to Krause, Scannell and Calantone (2000) supplier development is "…an activity undertaken by a buying firm to improve either supplier performance, supplier capabilities, or both and to meet the buying firm's short and/or long term buying needs." One way for a buyer to do this is through developing the competence of the supplier by providing expertise. According to Vachon and Klassen (2007) a buyer could assist a supplier to implement a quality management system, such as ISO 9001, to achieve this goal.

Supplier development programs typically focus on cost and total cost reduction, improved quality, enhanced flexibility and more reliable delivery (Krause, Handfield, & Tyler, 2007). It is important to make a distinction here between cost and total cost. Cost refers only to the cost price of a purchase whereas total cost refers to the purchase cost plus all additional costs required to support the initial purchase. One could speculate that BP Castrol, as a provider of chemical management services to Eskilstuna, would not be a candidate for a supplier development program given that the nature of their economic relationship relies on the expertise they provide to Eskilstuna. However, it is still interesting to consider the nature of such a relationship. For example one aspect of this relationship is that it involves some degree of long term commitment. Krause (1999) suggests that indeed, without a minimum level of commitment from a supplier, a buying firm may be unwilling to engage in supplier development.

The Volvo Group companies currently engage with service providers in a variety of ways both in terms of supply contract terms and also in the ways in which they work towards continuous improvement. It may be advantageous for a company such as AB Volvo to develop a global supplier development program to ensure that service providers are involved in the continuous improvement of not only Volvo Group companies, but their own operations as well.

3.7.3 Operational Knowledge Transfer Activities

There are four different types of supplier development including supplier assessment, providing incentives to suppliers, creating competition between suppliers and direct involvement (Krause et al., 2000). Direct involvement may require that a buying organisation invest human and organisational resources to develop the suppliers' performance. This phenomenon is know as operational knowledge transfer activity and involves a buying organisation clustering its personnel with supplier's personnel to transfer tacit knowledge and know-how (Modi & Mabert, 2007). It is important to make a distinction between explicit and tacit knowledge here. According to Grant (1996), explicit knowledge can be codified, written down and communicated. On the other hand tacit knowledge is highly specialised and typically resides in the individuals within an organisation. Grant (1996) points out that observation of any work team reveals closely coordinated working arrangements that require each team member to apply his/her specialist knowledge. This type of knowledge, tacit, is very difficult to write down and communicate through work procedures due to the complex relationships between the individuals and their expertise.

Modi and Mabert (2007) explain operational knowledge transfer activities very clearly: "Clustering of individuals from the procuring firm and vendor allows specific improvement activities to be performed facilitating the flow of non-codifiable tacit manufacturing and operations knowledge to flow across organizational boundaries of the involved firms." They exemplify this as a direct on-site assistance to suppliers or as bringing suppliers to the buying firm to observe and learn.

3.7.4 'Closeness'

Since operational knowledge transfer activities require a high degree of interaction between the buyer and supplier firm it is useful to consider the concept of 'closeness' from the buyer-supplier relationship perspective. In their recent work on the 'closeness' of this relationship Goffin and Lemke (2006) conducted an extensive literature review and concluded that partnership-like relationships are 'close' cooperations between manufacturers and their suppliers. The advantages of such a relationship include improved quality, lower costs and reliable delivery (Goffin & Lemke, 2006) also outlined by Krause et al. (2007) for supplier development programs.

In light of the advantages outlined above, understanding the nature of the relationships between manufacturers and suppliers is relevant and necessary in order to improve the management of those relationships. In an attempt to classify the nature of these relationships, Goffin and Lemke (2006) note that relationships can be based on the number of transactions, the longevity of the relationship and the closeness. Longevity is an important factor here considering that VCE CMP's relationship with BP Castrol is now in its second contract period. The closeness of a relationship is also relevant because the term 'close' has been used on multiple occasions to describe the relationship between VCE CMP and BP Castrol. It should be noted that partnership-like relationships, as defined above, are context dependant and based on how 'close' they are (Goffin & Lemke, 2006). In this sense, the degree of closeness can be used to explain relationships.

3.7.5 Technological Integration and Innovation

The nature of buyer-supplier relationships should also be considered from the perspective of change. In this case, continuous improvement could include changes to methods and processes as well as infrastructural and technological changes. One area of study focuses on the role of suppliers in participating in product and process development. According to Vachon and Klassen (2007) the resulting relationships require a richer communication setting to transfer technological knowledge and know how, something Grant (1996) refers to as tacit knowledge. In light of this, it is particularly interesting to note that, unlike lean production, interactions within this context typically revolve around project work rather than daily activities (Vachon & Klassen, 2007).

Technological integration, the process of a buyer and supplier integrating their activities, can be characterised as "…tacit knowledge sharing taking place between a buying and a supplying organisation in strategic areas like product development, process re-engineering and best management practices transfer" (Vachon & Klassen, 2007). Like other aspects of the buyer-supplier relationship, technological integration highlights the process of a buyer and supplier working together for the benefit of them both.

Since VCE CMP intends to carry out continuous improvement work, it is useful to attempt to categorise what types of work that might include. Jones and Klassen (2001), in an effort to classify the different types of environmental technology innovations, developed a framework outlining the relative degrees of competence destruction for different approaches to technological change (Figure 3-5). Competence destruction refers to the way in which an organisation will lose technological know-how in the event that it undergoes changes of some kind. According to Jones and Klassen (2001, p. 63), the greater the change in the organisation. the greater the loss of technological know-how.

To begin, any changes to the design of the chemical handling/management system at Eskilstuna must be viewed from the perspective that it actually contains two types of changes.

Firstly, system changes refer to the way the whole system could change. Secondly, component changes refer to changes to parts of the whole system. Henderson and Clark (1990) define these two key elements of innovation as the "System Architecture" and "Core Components" respectively. As shown in Figure 3-5, when a technological change involves very minor changes to the system architecture and/or core components of a system, the resulting changes can be classified as "Incremental," for example, end of pipe pollution control. At the other end of the technological change spectrum is "Radical" change, characterised by modified system architecture and modified core components. For example, the concept of a product may change completely.

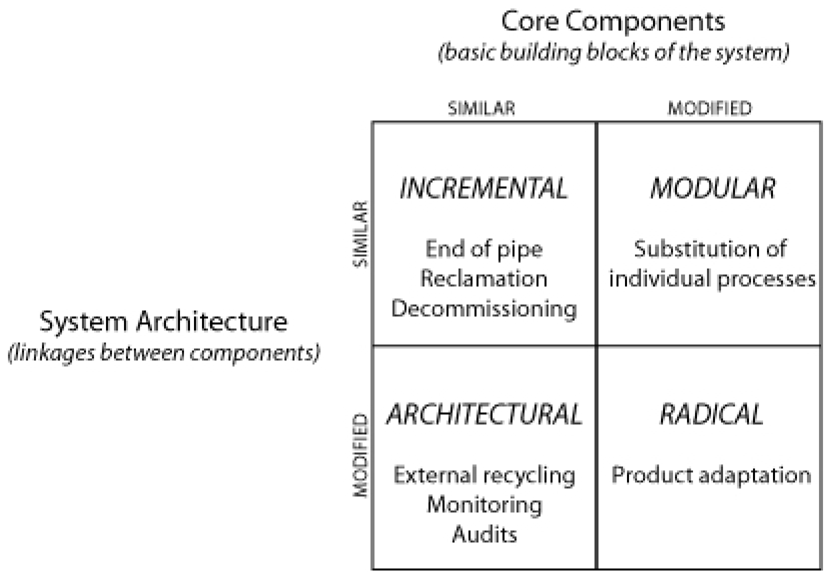


Figure 3-5 Framework for innovation in environmental technologies (Jones & Klassen, 2001, p. 64)

While Henderson and Clark refer specifically to product innovation, the same matrix can be used to classify equipment related modifications, as may be the case with continuous improvement at Eskilstuna. At the incremental level neither the core components nor the infrastructure of the system changes. Such a change at Eskilstuna might involve improving environmental performance by treating process chemical emulsions before releasing to the waste water treatment plant. The level of know-how destruction is very low at this level (Jones & Klassen, 2001). Modular changes involve changing individual parts of a system. At Eskilstuna such changes might include replacing a pump within the chemical handling/management system for a more energy efficient model. As Jones and Klassen (2001) point out, such changes do not drastically affect the other components in the system or the overall system itself. In the case where changes to the overall system take place, the architectural sector, the core components are largely unchanged but the way they relate to each other are modified. Adding a system that monitored the condition of process chemicals during use would be a change of this nature. The results of such a change would include changes to the work practice and inter-firm relationships (Jones & Klassen, 2001). Lastly, radical changes involve dramatic changes to both the components of the system and to the nature of the system itself. Changes of this type, for Eskilstunas chemical handling/management system, might involve complete redesign to incorporate reuse, recycling and monitoring, while reducing chemical consumption and minimising the infrastructure requirements. Such changes are more difficult to introduce because they potentially destroy much of the amassed know-how (Jones & Klassen, 2001). This model demonstrates that there are different types of technological change and that each of these, in differing degrees, involves more or less know-how destruction.

Loss of know-how is not something that an organisation typically wants to undergo. The result is that organisations that are highly technological, such as an automotive manufacturer, are also strongly inertial (Jones & Klassen, 2001). This means that once they are established on a technological path, it is difficult to deviate. To deal with the difficulties of change, organisational structures and processes must be developed to evaluate the trade-offs between the options for improving the system (Jones & Klassen, 2001). For Eskilstuna, any changes that affect only the components of the system would be much easier to achieve than changes to the components and the system. Component and system changes require much more coordination and typical mechanisms include team structures, cross functional communication and internal exchange of personnel (Jones & Klassen, 2001). Jones and Klassen (2001) also identify the existence of a 'firm's way of doing things,' highlighting the way that as an organisation conducts changes to its products and processes, it develops a base of knowledge relating to problem solving. Does the same kind of knowledge and learning experience exist at Eskilstuna? How could such knowledge be harnessed?

3.8 A Theoretical Model for Buyer-Supplier Continuous Improvement

Literature revealed a number of elements that could characterise a successful model of engagement between a buyer and service provider working towards continuous improvement and sustainable development. The approaches to continuous improvement provided the following elements such that a model of engagement should:

- generate and maintain a **culture** of continuous improvement,
- **involve all** employees in the process,
- be based on the **PDCA** cycle,
- utilise **permanently formed teams** to conduct improvement work – quality control circles,
- be based around the goals of **eliminating waste**, and
- maximise **overall equipment effectiveness**.

Under the influence of an EMS, such as ISO 14001:2004, the model should:

- generate and maintain a **culture** of continuous improvement,
- be based around the **PDCA** cycle,
- utilise the **team** based approach,
- expand the focus of lean production **beyond traditional lean wastes**,
- offer a **life cycle perspective** to a lean production system, and,
- allow for **material substitution** within a lean production system.

With respect to buyer-supplier relationships, the model should:

- utilise **joint problem solving** in **cross functional** teams
- encourage **long term commitment** from both buyers and suppliers,
- encourage **direct involvement** of the buyer in the suppliers organisation and vice versa, and,
- build partnership-like **close** relationships.

When viewed in whole a very significant trend emerges where teams should form the basis of any engagement between buyers and service providers. This engagement should create a close relationship between the organisations allowing for joint problem solving, encouraging long term commitment and involving all in a process of continuous improvement based on the PDCA cycle.

4 The Volvo Case

The findings presented here are specific to the case of continuous improvement of the chemical handling/management system at VCE CMP's Eskilstuna production facility. These findings are based on data gathered through Volvo Group documentation review and interviews of key actors (see Section 1.7). Analysis of findings against the theoretical model contained in Section 3.8 allowed for preliminary conclusions to be made about how the actors and systems, involved with the Eskilstuna upgrade, could be organised to ensure continuous improvement.

This chapter provides answers to the following sub questions:

- How is 'continuous improvement' defined by the different actors and systems?
- How are the actors and systems currently organised to work towards continuous improvement?
- What are the links between the actors and systems?
- How are continuous improvement activities related to the EMS/BMS?
- Which actor and system elements exist, within Volvo Group and BP Castrol, to fulfil the requirements of a theoretical model for engaging service providers in continuous improvement?

4.1 Actors

A stakeholder analysis was conducted to determine which individuals, organisational units and BAs/BUs within the Volvo Group held an interest in the continuous improvement of the chemical handling/management system at Eskilstuna. This analysis also revealed which individuals, organisational units and businesses outside the Volvo Group held an interest in the continuous improvement of that system. The results of this analysis are presented graphically in Figure 4-1 below and provide an answer to the sub question; how are the actors and systems currently organised to work towards continuous improvement? This figure should be referred to for clarification of the following text.

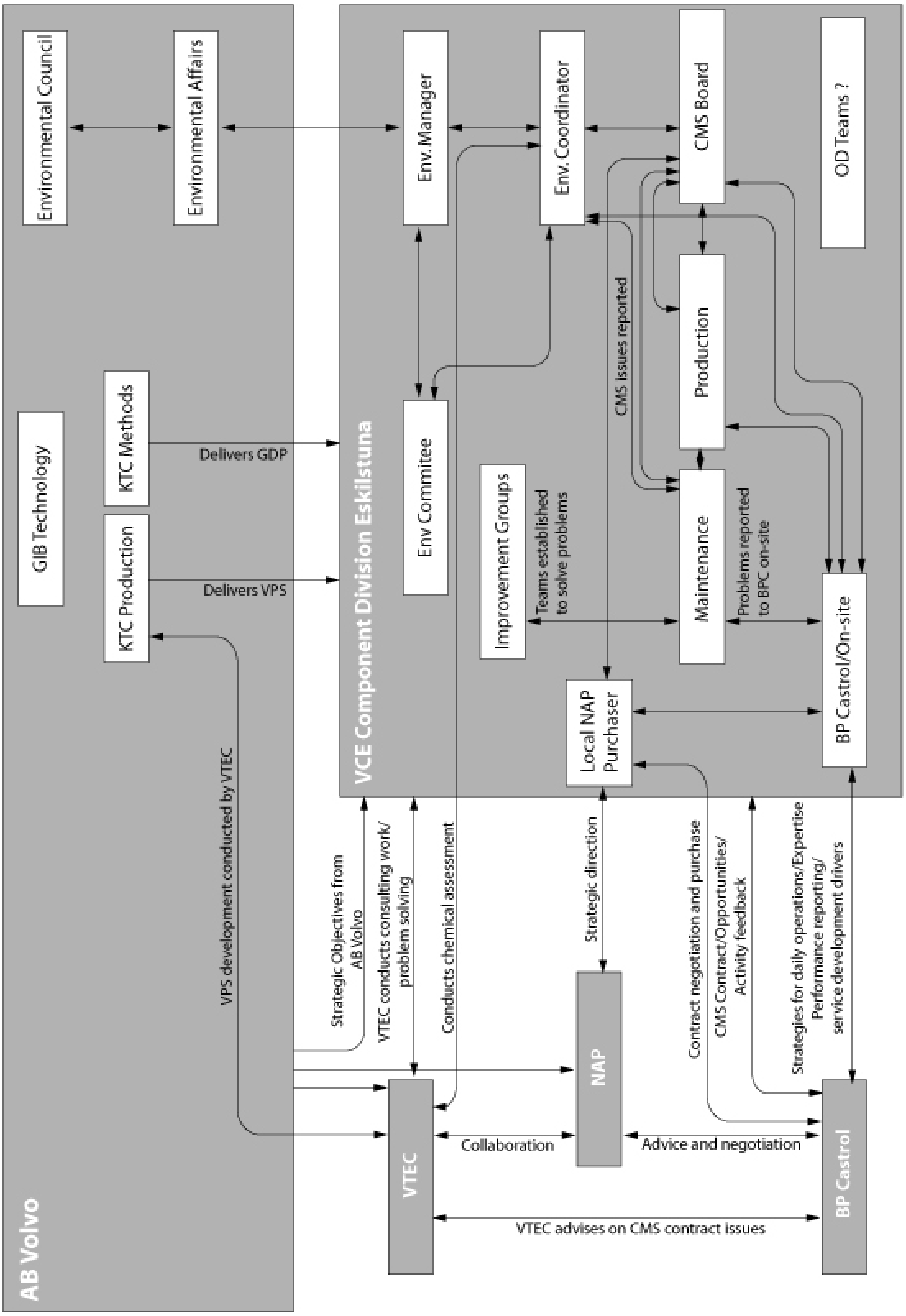


Figure 4-1 Actors and their relationships

Figure 4-1 indicates the links that exist between the relevant actors and highlights the nature of some of these interactions. For full explanations of the interactions refer to Sections 4.1.1 – 4.1.10. Arrows indicate the direction of interaction between actors.

4.1.1 AB Volvo

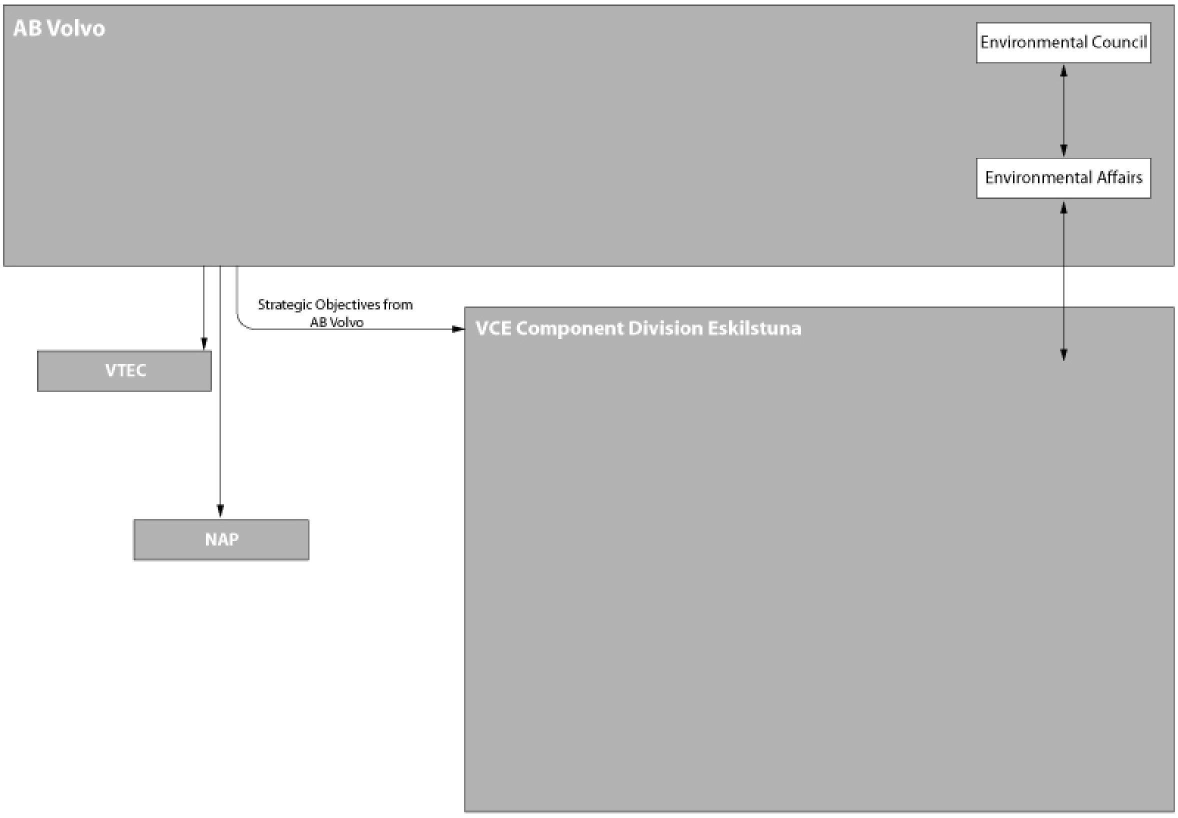


Figure 4-2 AB Volvo links and interactions

AB Volvo is far removed from the practical problems faced at Eskilstuna. However, the approaches taken at Eskilstuna are directly affected by the policies, strategies and culture established at the Volvo Group level. Specifically, the environmental, quality and safety policies play a significant role in driving all daily work and establish the overall approach that all Volvo Group work should adhere to. In addition the strategies established by AB Volvo determine the direction in which the Volvo Group is heading and assists in pushing all Volvo Group companies to achieve their long term goals. In terms of goals, the vision and mission provide very clear end points for all of Volvo's activities. The Volvo Way, a document outlining the Volvo culture, guides individuals to understand what it means to conduct activities under the Volvo brand name (Volvo, 2004c).

AB Volvo directly influences the strategies developed by Volvo Group Non-Automotive Purchasing (NAP). There is one key strategy here – reduce costs.

With respect to environmental work, AB Volvo delivers environmental targets and objectives.

Strategic Goals are delivered by AB Volvo to all Bas and BUs in the Group.

AB Volvo is responsible for reporting many aspects of the Group's performance. AB Volvo releases annual reports, which includes a section on environmental performance, and is audited regularly for economic, environmental and quality performance.

4.1.2 Volvo Technology

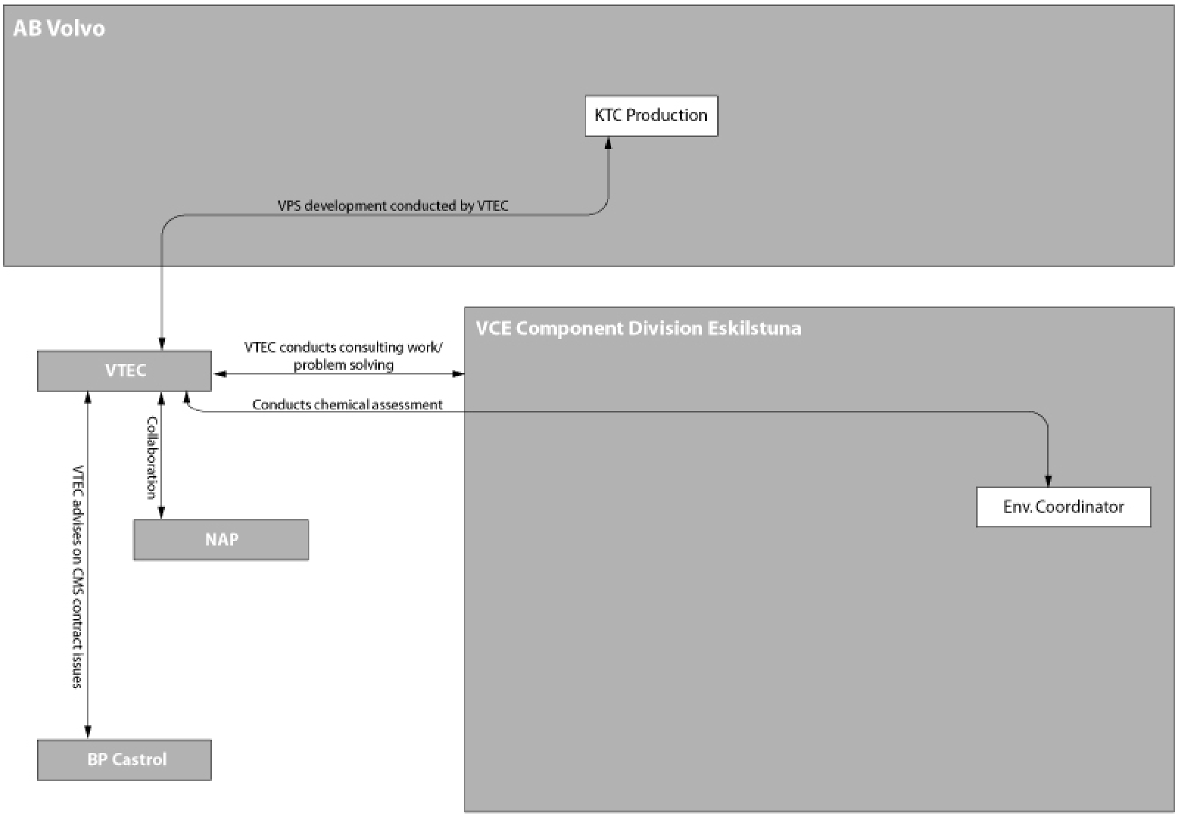


Figure 4-3 VTEC links and interactions

As an internal consulting organisation, VTEC possesses expertise in a broad range of disciplines. One of its most well-established areas of expertise is in dealing with chemicals. Contrary to the literature, that suggests that chemical management is often not a core competence of user companies, it is apparent that VTEC does possess a significant amount of expertise in chemistry, chemical assessment and application of chemicals in industrial processes. While it can be argued that chemicals are a core competence, it is conceded that the management of those chemicals on-site is, perhaps, not a core competence of VTEC.

One of VTEC's primary functions is to develop 'hard' and 'soft' technologies and concepts for products and processes within the automotive industry. However, their work is not limited to application within Volvo Group companies. With respect to process development, it is VTEC's responsibility to investigate the application of continuous improvement in Volvo Group companies. They will soon begin an auditing procedure that will investigate each Volvo Group company's efforts in continuous improvement. This audit procedure will form the basis to then phase in the Volvo Production System (VPS – see Section 4.2.4).

Chemical assessment is a core competence of VTEC and they perform this function on behalf of the entire Volvo Group. This system, discussed in Section 4.2.9, results in the classification of chemicals into a database called MOTIV that keeps track of all chemical products in use at any Volvo Group establishment. MOTIV is the responsibility of VTEC and Volvo Group companies will often ask VTEC to conduct a chemical assessment on their behalf. In this way, VTEC is linked to individual facilities through the classification procedures.

With respect to its involvement with Eskilstuna, VTEC has been contracted by Eskilstuna representatives to conduct an investigation into the optimisation of their CMS contracts. In addition, VTEC is investigating the role of service providers in working towards continuous improvement. This is, however, not the extent of their relationship. Environmental personnel at Eskilstuna work closely with VTEC personnel on many aspects of operations including chemical management, waste management and other specialist areas of which VTEC has more expertise.

To ensure the successful continuation of the CMS contract at Eskilstuna, VTEC performs the role of advisor to both VCE CMP and BP Castrol with respect to issues pertaining to the contract between them. In the case where BP Castrol needs to discuss issues they are having with the contract, whether these are practical, legal or other, VTEC will advise them on a course of action. It appears that VCE CMP, BP Castrol and VTEC have very strong relationships with each other often classified by interviewees as 'close.'

4.1.3 Volvo Group NAP

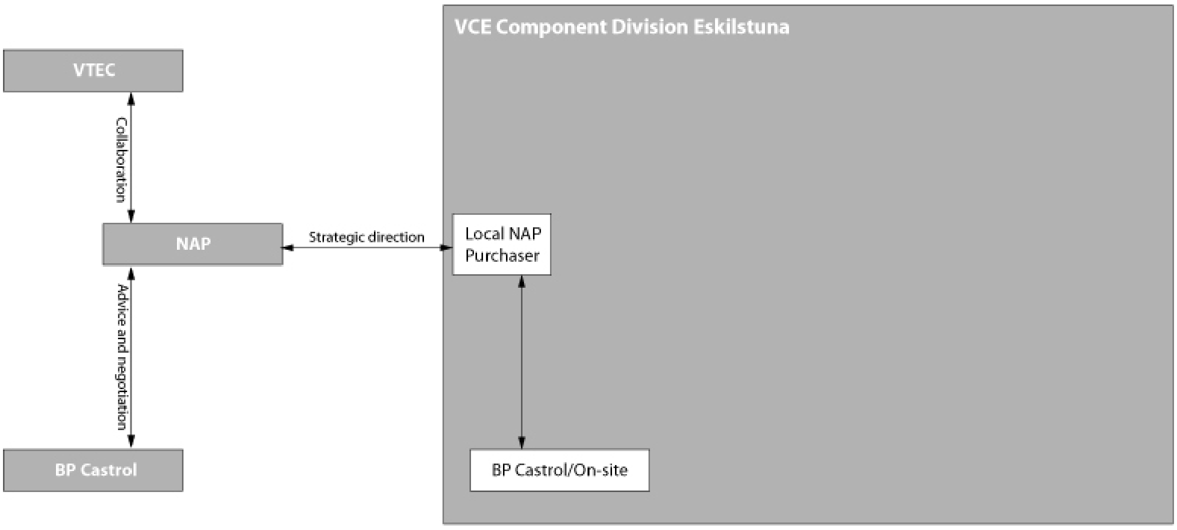


Figure 4-4 NAP links and interactions

Volvo Group Non-Automotive Purchasing (NAP) is the global procurement organisation sourcing indirect goods and services[1] for all Volvo Group companies. NAP's mission is to purchase high quality indirect goods and services at the lowest Total Cost of Ownership[2] while monitoring and controlling costs to ensure sustainable and profitable growth (Volvo, 2006c). NAP strives to consolidate spending volumes, minimise the supplier base and drive the standardisation of products and services. In achieving these goals NAP views suppliers as an extension of Volvo Group operations and works towards establishing long-term relationships with preferred suppliers fulfilling the theoretical requirements of direct involvement and long term commitment.

As a purchasing organisation, NAP's primary goal is to minimise costs. One strategy for achieving this goal is engaging in service provision contracts such as the CMS contract in place at Eskilstuna. NAP is linked to this contract in three ways. Firstly, on a strategic level, the

[1] Indirect goods and services are classified as any purchaseable that is not included in the final Volvo product. Examples include production machinery, office equipment, packaging and utilities (Volvo, 2006c).

[2] Total Cost of Ownership (TCO) is a term used when referring to the total costs associated with the purchase of a product or service. For example, this might include costs associated with increased handling and care, training of personnel, technical and health and safety assessments, monitoring, use phase costs and disposal.

global strategic buyer for chemicals establishes purchasing strategies specifically for the purchase of chemical products and services. CMS contracts are this individual's responsibility. In this case, a strategy has been established that minimises the costs associated with chemical provision by engaging in CMS contracts. Secondly, personnel at this level also act as advisors to Eskilstuna and BP Castrol when there are issues raised regarding the contract. Thirdly, on a local level, a local NAP purchaser is responsible for conducting purchasing activities including the negotiation of CMS contracts. It is important to note that in this case, strategic level NAP personnel were involved with the negotiation of the CMS contract at Eskilstuna. Being a relatively new strategy, a higher level of strategic involvement was required to ensure successful negotiation and implementation. This involvement continues today with NAP's ongoing involvement in contract modifications. In particular, on advice from VTEC, such as a change of technology or in the case of a contract problem, NAP may alter the terms of a CMS contract.

NAP also place demands on suppliers in the form of environmental requirements for suppliers as described in Section 4.2.13.

4.1.4 Volvo Construction Equipment Component Division

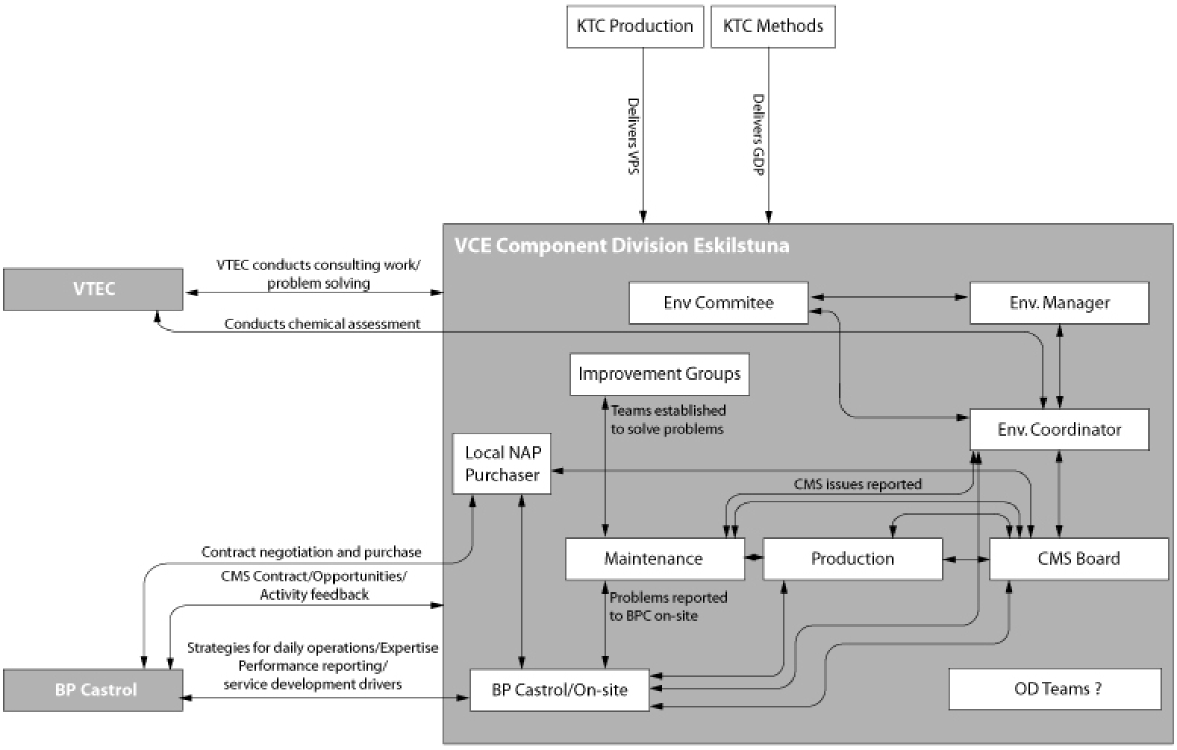


Figure 4-5 VCE CMP links and interactions

A number of organisational entities and functions of relevance exist within the VCE Company. On a strategic level, this company delivers the strategic goals for all of VCE's activities, in alignment with AB Volvo's strategic objectives (see Section 4.2.3 for an outline of the Strategic Objectives).

As described in the Scope (Section 1.4), VCE CMP is responsible for the facility at Eskilstuna. In particular, the infrastructure within the chemical handling/management system is owned and operated by this company. VCE CMP's primary role in this case is that they are the purchaser of BP Castrol's products and services via a CMS contract.

VCE's Component division is very closely linked to VTEC through a series of projects, some of them ongoing. A number of projects have been undertaken at Eskilstuna including dimensioning of the waste water treatment system, investigating cleanliness of cleaned parts, biological paint sludge reduction, measuring oil mist and securing oil quality. These projects indicate that Eskilstuna utilises the expertise available at VTEC. In addition to these projects, Eskilstuna also benefits from a number of Group-wide projects addressing production standards, simulation, metal-working fluid and cleaning system development, monitoring and maintenance technologies. It is apparent that there is a close link between Eskilstuna and VTEC.

4.1.5 CMS Board

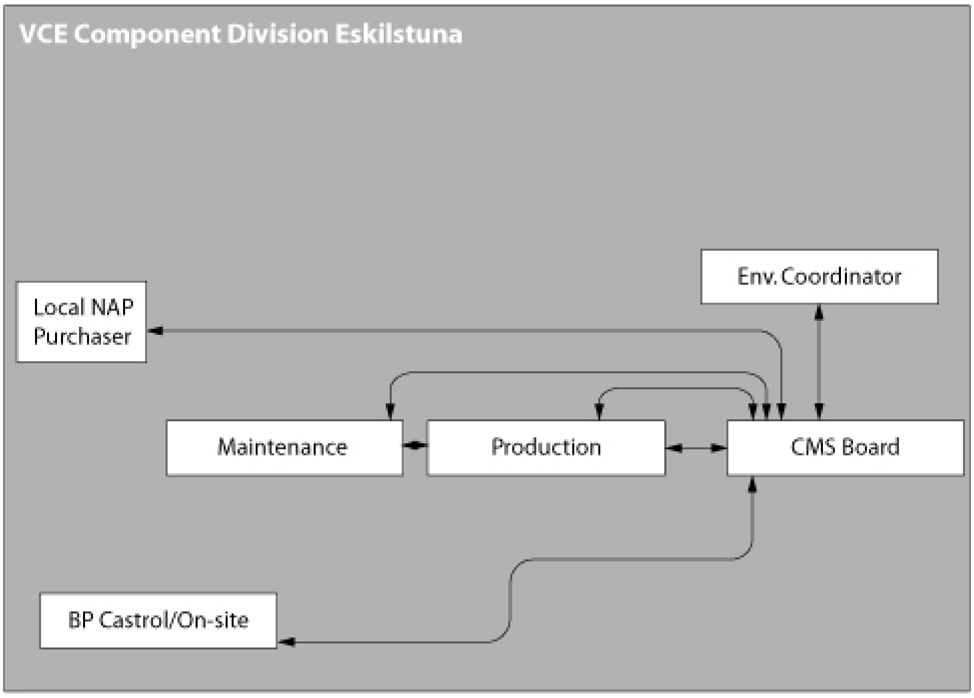


Figure 4-6 CMS Board links and interactions

Within VCE CMP, Eskilstunas Chemical Management Services Board (CMS Board) is comprised of the facility's environmental coordinator and a number of representatives from production, maintenance, purchasing and the service provider. This group meets four times a year and its major task is to resolve issues regarding the CMS contract as raised by its representatives. It is often the case that environmental issues are reported by production, maintenance or BP Castrol, to the environmental coordinator who then raises the issue at these meetings. However, it is sometimes the case that a shop-floor problem is dealt with by the appropriate production, maintenance or BP Castrol personnel. Sometimes, the problems are dealt with sufficiently and are not reported further. In any case, the CMS Board provides a very important forum for reporting problems and determining actions for their resolution.

4.1.6 VCE Component Division Maintenance Department

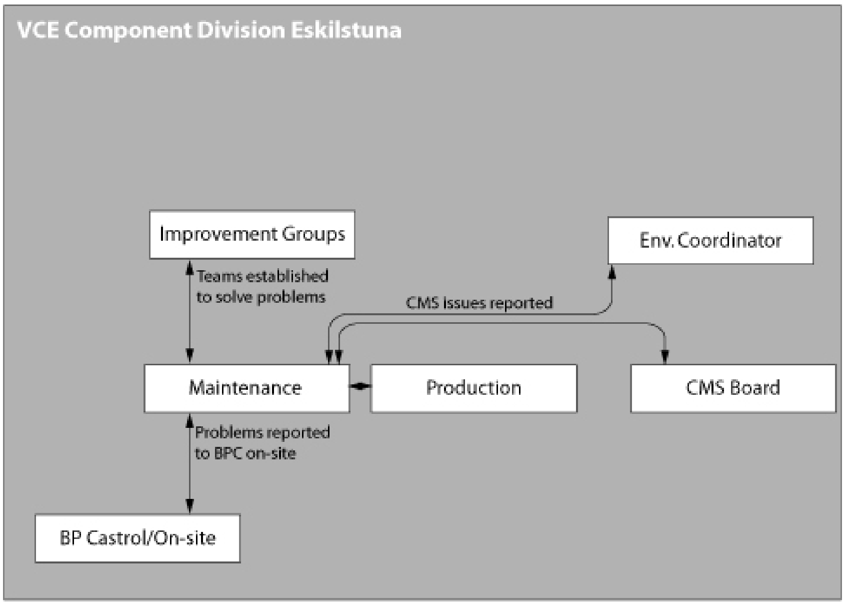


Figure 4-7 VCE CMP Maintenance links and interactions

Within VCE CMP is a maintenance department that is responsible for a number of significant aspects of Eskilstunas operations. This group contains five subgroups working in various areas, one of which is Maintenance and Tools. This group is responsible for, among a very long list of subjects, preventive maintenance, equipment support, breakdown analysis, service agreements for machinery and the establishment of improvement groups. The establishment of improvement groups is a very important function that is perhaps overlooked in terms of its ability to deliver contributions to the design of the chemical handling/management system. These groups will be discussed further, later in this section.

As discussed in Section 4.1.7, BP Castrol's actions are carried out at Eskilstuna by on-site staff. If there is a technical issue with the way these actions are being carried out it is normally the job of VCE CMP personnel to report to one of the five maintenance managers. These managers are then responsible for reporting the issue to BP Castrol on-site, and to the CMS Board if necessary, who should then act to rectify the situation. This line of communication does not involve the environmental coordinator or manager unless it is a persistent issue or an issue that is outside the on-site staffs' capacity to rectify. In this case, the maintenance department may report the issue to the environmental coordinator who then reports it to the CMS Board for consideration.

In some cases, technical problems are reported directly to the production managers responsible for chemicals who the take the appropriate actions. In these situations, it may be the case that the problem is dealt with without the involvement of the environmental coordinator or the maintenance department. It should be reinforced that this is only the case when a problem is of a practical nature and is not persistent. Still, a very strong link exists between the maintenance and production functions.

It was revealed that the line of communication between the maintenance department and BP Castrol on-site could be improved. The problem with this relationship is that since there are five maintenance managers, each operating in different areas of expertise and also operating over five shifts, there is no single point of contact for BP Castrol within the maintenance department. One interviewee believed that this relationship could be improved by removing this relationship and replacing the contact with the maintenance department with a single contact person. In other words, one person would be responsible for relaying information regarding issues between VCE CMP and BP Castrol. Some problems arise from this organisation however. With the component division's activities operating over five shifts, this would require the reporting of issues by this person, almost 24 hours a day.

VCE CMP's maintenance department has the power to form Improvement Groups. The purpose of such groups varies but is based on solving a specific problem that has occurred within the Eskilstuna facility. For example, if a bottleneck in production is occurring, causing persistent problems, an improvement group could be formed to investigate the cause of the problem and identify actions to be taken to rectify the problem. This group would then facilitate the necessary actions, report the improvements and then disband. This type of group is roughly in line with the type of teams used within a lean manufacturing context. As with lean production teams, the improvement group is essentially trying to solve a problem related to some form of waste - in the above example, it is downtime. It could be argued that these improvement groups are already in line with lean production theory and will be compatible with the forthcoming VPS.

4.1.7 BP Castrol

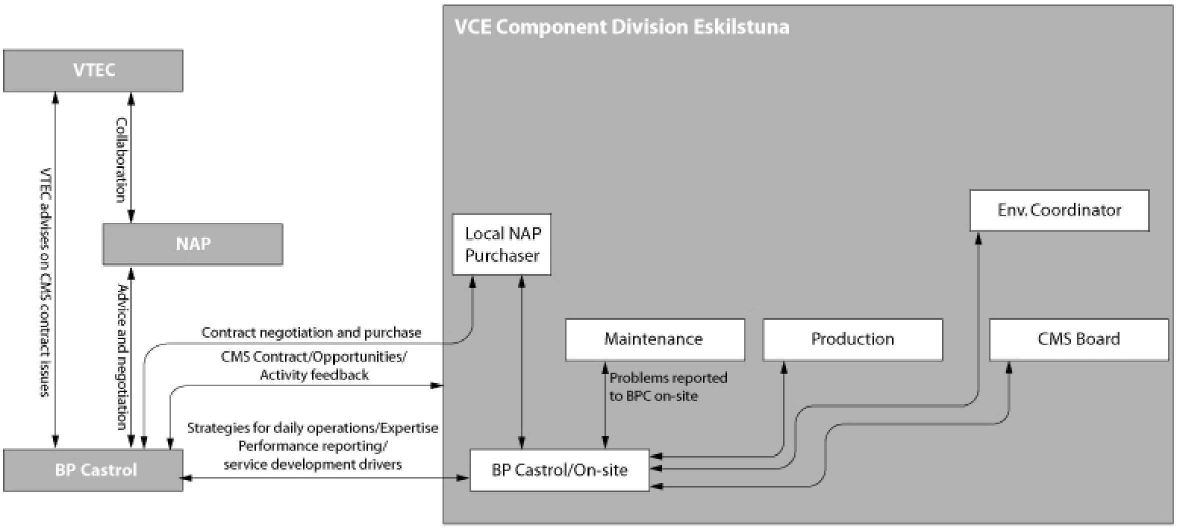


Figure 4-8 BP Castrol links and interactions

BP Castrol is the provider of chemical management services to the VCE CMP facility at Eskilstuna. The terms of their contract stipulate that they provide agreed products and services in return for remuneration per unit of service or per hour.

Within the terms of the contract, the necessary actions are carried out by a two person team of BP Castrol personnel who work on-site, full-time and in close cooperation with production personnel. It is important to understand that this team is at an operational level that does not have the same roles as the strategic level of BP Castrol. These two entities are referred to in the model as BP Castrol, the strategic level organisation, and BP Castrol on-site, as the operational level organisation.

In essence, BP Castrol strives to optimise product use at Eskilstuna by working closely with VCE CMP to identify opportunities for better management. This is a contract based on the sustainable flow of ideas, information and projects to deliver savings to both VCE CMP and

BP Castrol. What VCE is really paying for, apart from the fulfilment of technical services, is the expertise of BP Castrol. This expertise includes an in-depth understanding of the products being used as well as an understanding of the systems in which they are used.

In addition to the technical requirements, set out above, BP Castrol ensures that information regarding their activities on site is flowing back to Volvo. They do this based on information being reported back via BP Castrol on-site. This information is mostly data compiled regarding key performance indicators (KPIs) and reflects how well BP Castrol is fulfilling the terms of the contract.

BP Castrol continuously works towards standardising and harmonising the approaches to chemical management at all of its operations. For example, through the dissemination of best practices and implementation of continuous improvement projects, it is able to harmonise operations for the most effective outcome. On that note, in an effort to avoid complacency in their contracts, BP Castrol commit themselves to carrying out one or two continuous improvement projects per year within a contract. It is not clear whether these projects have been carried out at Eskilstuna and, in the event that they were, whether or not VCE CMP deemed them successful. However, it is evident that BP Castrol, VCE CMP, VTEC and NAP have very close and mutually beneficial relationships.

In the past, joint projects have been conducted successfully and have strengthened the ties between BP Castrol and VCE. For example, one interviewee revealed that the companies have previously worked together to realise a rapid diagnostics project for process fluid sampling. This project involved the development and implementation of a system that allowed the rapid evaluation of process fluids to diagnose any problems and take immediate action. The advantages of this project include extended product life, both chemical and machinery, reduced waste volumes and greater tool performance. One interviewee revealed that BP Castrol enjoyed a special relationship with their Volvo Group partners because they recognise that development projects sometimes have failures. It was suggested that Volvo Group partners were more understanding, even forgiving regarding failures and that this helped strengthen their relationship with BP Castrol.

Volvo is considered a key account by BP Castrol due to the large amount of money they spend and the extent to which they engage with BP Castrol's services.

With its key function being to deliver expertise in chemical related products and services, BP Castrol contains a Marketing and Technology department. This department is responsible for investigating and developing new methods and technologies. For example, this group is currently involved with the investigation of new cutting fluids and cleaners as well as improving tool performance and related hardware. It appears that there is no relationship between this development department and the various development groups at VCE CMP. However, creating a link between these departments may enhance the pace of improvement through joint problem solving.

BP Castrol is linked to VTEC since VTEC is an advisor for the CMS contract. In addition, VTEC is able to drive changes to the CMS contract through influencing NAP who, in turn, can alter contract terms. BP Castrol is also influenced by VTEC's investigations into alternate technologies and methods for chemical management. In the event that VTEC identifies an opportunity, a requirement can be established, such as a specification to be met, driving BP Castrol to facilitate a change.

4.1.8 Environmental Organisation

With 'environmental care' as a core value of the Volvo Group it is not surprising that there is an extensive network of groups and individuals working on environmental issues. Volvo Group's environmental organisation is decentralised meaning that there are a number of strategically placed positions to ensure that environmental performance is part of daily business and to regulate legal compliance. Figure 4-9 graphically represents the environmental organisation and indicates which of the environmentally related positions are engaged with the CMS contract at Eskilstuna.

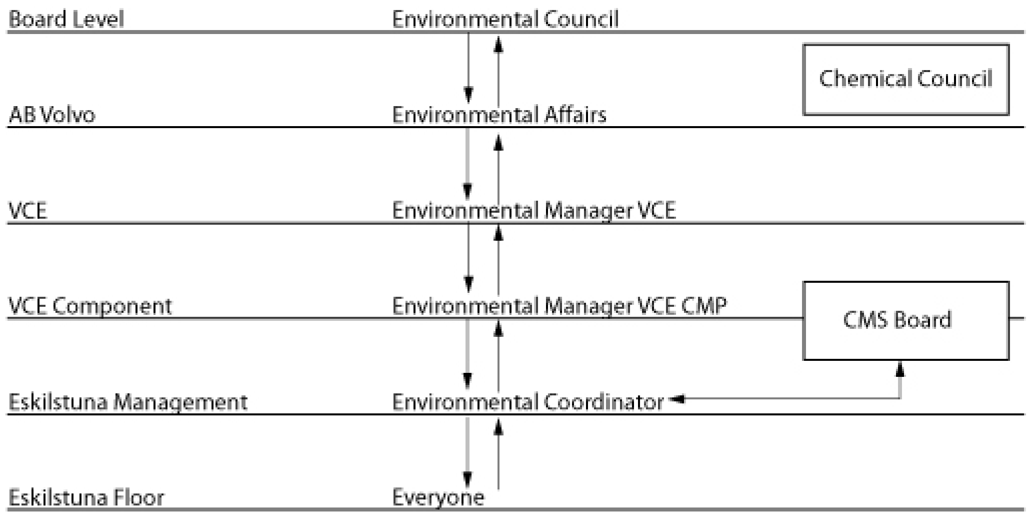


Figure 4-9 Environmental Organisation: Level of operation, position and advising councils

At Group level an Environmental Council, chaired by a member of the Group Executive Committee, acts as the advising body for all group level decisions. This group is made up of environmental managers and representatives from AB Volvo Environmental Affairs. Environmental Affairs is a unit of AB Volvo that is responsible for the coordination of the Group's environmental strategies and follow up actions.

On a company level, every BA and BU contains an Environmental Manager who is responsible for the coordination of environmental strategies in that unit. On a plant level, environmental coordinators manage the daily functions required for environmental management.

Within VCE CMP at Eskilstuna, environmental management is handled by the Quality Development department (Figure 2-4) according to the ISO 14001:2004 standard. In this group, the environmental manager also manages groups for Management Systems and Methods Development and Component Revisions. The environmental coordinator is one of three individuals working in the Management Systems and Methods Development group (Figure 2-6). It appears that this structure is reasonably effective in achieving daily environmental management tasks.

The role of the environmental coordinator at Eskilstuna is to coordinate the daily activities relating to environmental work, within the framework of Eskilstunas ISO 14001:2004 certified EMS. This typically involves taking action on oil spills and waste handling issues, assessing chemical usage and trying to reduce consumption, phasing out chemicals based on MOTIV assessment data, working on internal auditing, maintaining and updating EMS documentation and numerous other tasks. In addition to this role, this individual is responsible for advising on the safe handling of dangerous goods and is the coordinator for the CMS contract in place at Eskilstuna. This role involves reporting information to BP Castrol and reporting issues raised in the facility to the CMS Board. Maintaining contact with the relevant authorities is also handled by the environmental coordinator.

4.1.9 GIB Technology

The Volvo Group contains a number of Group Issue Boards (GIBs). These boards are charged with gaining benefits and accelerating the pace of development and change within the Volvo Group. One of the four GIBs is Group Issue Board Technology (GIB Technology). This group, like the others, consists of representatives from all operating sectors in the Volvo Group and conducts decision-making at a group level.

Within GIB Technology, there are a number of key technology committees (KTCs). One such group is KTC Production whose role is to act as a steering committee for the development and facilitation of Volvo Group's production system. They should achieve this by initiating Group level activities including (Volvo):

- Initiating cooperative efforts in areas of common interest,
- Developing medium and long term scenarios and visions,
- Monitoring ongoing and planned production development projects,
- Identifying areas where common standards and procedures can be applied,
- Enhancing knowledge sharing,
- Providing a focal point for production related issues.

One of the goals of these activities is to create a common set of Volvo production management principles. This is now termed Volvo Production System (VPS - see Section 4.2.4) and is currently in the final stages of the development process. Documentation review revealed that KTC Production should give priority to projects that present an opportunity to work with skilled partners (Volvo). It is not clear whether this could include working with a chemical management service provider. However, it could be argued that engaging a CMS provider in a group wide development process is not in conflict with this priority setting.

KTC Methods is another group within GIB Technology that deserves some attention. This group is responsible for developing and assisting the implementation of the Global Development Process (GDP – see Section 4.2.8) throughout the Volvo Group. This group is currently assisting VCE to harmonise their existing development process and project assurance plan with the new common GDP process.

4.1.10 Operational Development Teams

Operational Development (OD) is a business model used to transform the goals and targets of the Volvo Group into actionable agendas at team level (Volvo, p. 3). There is currently no link between the continuous improvement of the chemical handling/management system at Eskilstuna and operational development teams. However, improvement groups, those formed by the maintenance department, perform a similar function and operate in a similar way to operational development teams. Although the teams are not called operational development teams, it appears that teams for problem solving do exist.

4.2 Systems

Briefing discussions revealed a number of systems that existed within the Volvo Group that may influence the upgrade of the chemical handling/management system at Eskilstuna and subsequent continuous improvement work. Interviews with key personnel, working with these systems, revealed further information regarding the systems role, and the individuals own role, in relation to upgrade and continuous improvement activities at Eskilstuna. The findings presented and discussed here were selected based on their potential to affect the actions taken to continuously improve the chemical handling/management system. In other words, these systems are the most intimately related to the Eskilstuna case and provide insights into how the engagement between VCE CMP and BP Castrol could be carried out.

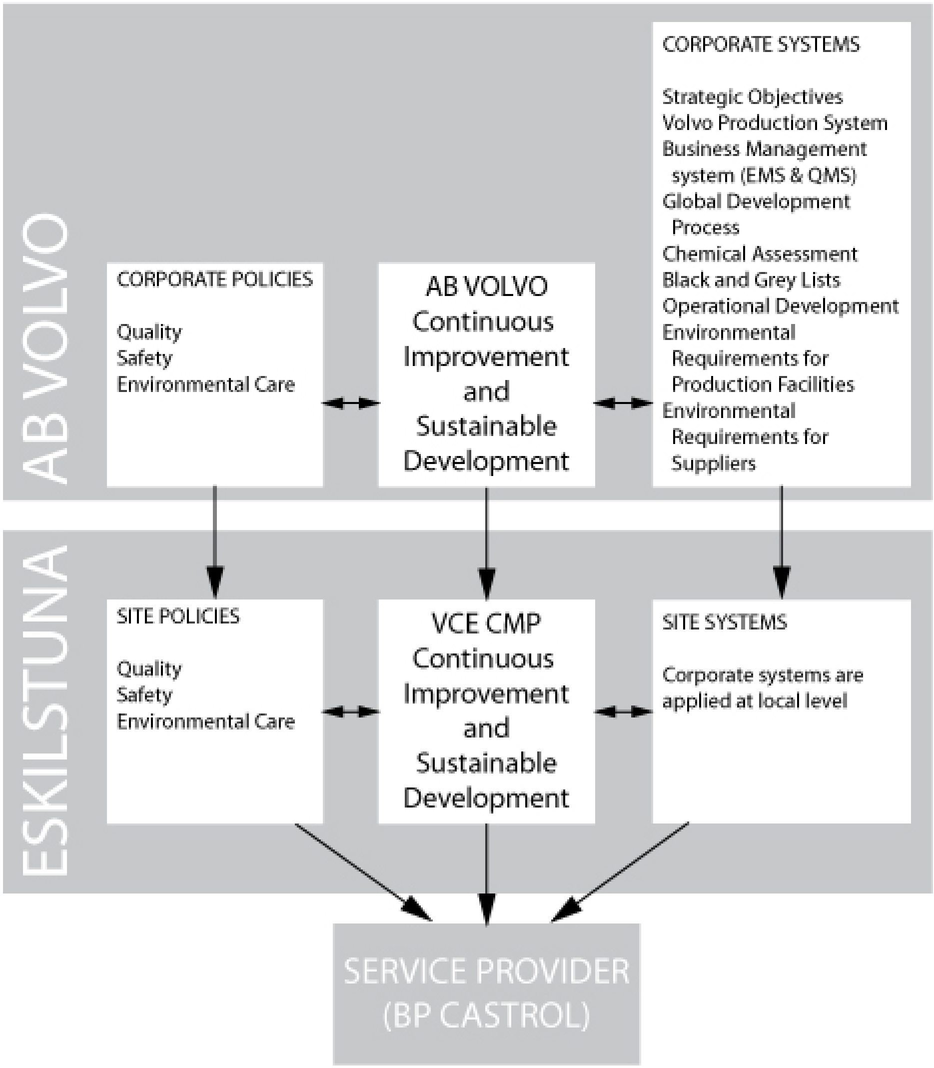


Figure 4-10 Interaction between Volvo Group's and Eskilstunas policies and systems and BP Castrol

Figure 4-10 indicates the relationships between the corporate and site policies, the corporate and site systems and between corporate and site continuous improvement activities. At the corporate level, policies and systems affect the approach taken to conducting continuous improvement. In turn, that affects the approach taken to continuous improvement at site level. Policies, systems and continuous improvement each affect the service provider (BP Castrol). The following sections outline the policies and systems for continuous improvement and sustainable development present in the Volvo case.

4.2.1 Defining Continuous Improvement

In order to be able to work towards continuous improvement it is essential that the Volvo Group present a consistent definition of the term to all Group companies. Currently, it appears that the term is defined differently in a number of different systems creating some confusion about what continuous improvement actually means. The definitions of the term are discussed here as provided by the international standards for environmental and quality management systems, AB Volvo's environmental and quality policies and the definition provided in the VPS. These definitions are provided in Table 4-1 below:

Table 4-1 Definitions for 'continuous improvement'

System	Comments on 'continuous improvement'
AS/NZS ISO 14001:2004 (Section 3.2)	Continual improvement is the recurring process of enhancing the environmental management system (3.8) in order to achieve improvements in overall environmental performance (3.10) consistent with the organization's (3.16) environmental policy (3.11)
AS/NZS ISO 9001:2000 (Section 8.5.1)	A definition of continuous improvement is not provided. However it is stated that: The organization shall continually improve the effectiveness of the quality management system through the use of the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions and management review.
AS/NZS ISO 9000:2006 (Section 2.9)	The aim of continual improvement of a quality management system is to increase the probability of enhancing the satisfaction of customers and other interested parties. Actions for improvement include the following: a) analysing and evaluating the existing situation to identify areas for improvement; b) establishing the objectives for improvement; c) searching for possible solutions to achieve the objectives; d) evaluating these solutions and making a selection; e) implementing the selected solution; f) measuring, verifying, analysing and evaluating results of the implementation to determine that the objectives have been met; g) formalizing changes. Results are reviewed, as necessary, to determine further opportunities for improvement. In this way, improvement is a continual activity. Feedback from customers and other interested parties, audits and review of the quality management system can also be used to identify opportunities for improvement.
AB Volvo Environmental Policy (see Appendix II)	Our environmental activities shall be…improved continually by: • formulating, communicating and monitoring clearly-defined goals; • involving our employees.
AB Volvo Quality Policy (see Appendix III)	We shall identify, document and continuously improve our processes by: • working toward achieving maximum customer value, and zero defects; • establishing, working toward, and monitoring our results against measurable process objectives;

	• comparing ourselves with others, and learning from the best.
Volvo Production System	Continuous improvement is a documented process of identifying and implementing improvements, based on standardisation and employee involvement, and completed according to the PDCA cycle.

It is clear that while these definitions are not in conflict with each other there are some slight differences between them. For example, ISO 14001:2004 focuses the improvement activities on enhancing the environmental performance of the organisation while ISO 9000 series focuses on improving the organisation's ability to satisfy customers and other interested parties. A similar difference can be seen between the environmental and quality policies of AB Volvo where environmental activities shall be continually improved by working towards clearly defined goals and quality shall be improved by working toward achieving customer value. While there are minor differences these policies do not detract from each other and provide a very good basis for a wide range of value adding improvements both from the environmental and quality perspectives.

The VPS definition is of particular importance here because this system is the most likely forum for improvement activities. In an attempt to provide a very broad definition of continuous improvement, the principles of both the ISO environmental and quality management systems were drawn upon. At the centre of this definition is the PDCA cycle (also at the centre of ISO 14000 and 9000 series). In addition this definition includes that continuous improvement requires employee involvement, also a major part of both ISO systems.

With the implementation of the forthcoming Business Management System (BMS - see Section 4.2.5) the definitions of continuous improvement may be consolidated removing any confusion about what should and should not be considered continuous improvement. In the meantime, however, interviewees revealed that, depending on what the focus of work might be, a variety of definitions could be used to classify improvement work. As noted above, these definitions are not in conflict with each other, however it would surely simplify the improvement process if all personnel were familiar with one understanding of the term. This would also improve the commonality of the Volvo Group's work (one of the key goals of the VPS).

4.2.2 Policies for Continuous Improvement

In line with its three core values, AB Volvo has delivered a policy document for each to serve as a driver for, and guidance for, all Volvo Group companies' actions. Review of these policies revealed some key information indicating that a culture of continuous improvement exists, or should exist within all Volvo Group companies. While the environmental (see Appendix II) and quality (see Appendix III) policies contain numerous references to continuous improvement, teamwork and other aspects in line with continuous improvement approaches, the safety policy did not offer any of the same commitments. For this reason it is not discussed any further.

Signed off in 2004, the environmental policy (Volvo, 2004a) contains four principles; an holistic view, continual improvement, technical development and resource efficiency. Interestingly, all four of these principles contain references to actions that could be used to classify the continuous improvement work to be conducted at Eskilstuna. The holistic view element refers to the way in which Volvo's actions should take account of the complete life cycle of products and processes indicating that they are aware of and committed to understanding the true impacts of their products and processes. Consideration of the environmental impacts of the chemical handling/management system is clearly within the scope of the environmental policy. This policy also states that all suppliers, dealers and business partners should adopt the principles contained in the policy. BP Castrol's actions, therefore, are well within the scope of the environmental policy. It remains to be seen how BP Castrol respond to these requirements and whether or not they do adhere to the principles contained in the environmental policy.

Continual improvement, as the title indicates, refers specifically to the integration of environmental work in daily activities and the continuous improvement of them through formulating, communicating and monitoring clearly defined goals. More importantly, in accordance with lean approaches, a special focus is placed on involving all employees. In addition to the continuous improvement of environmental activities, the technical development principle highlights the need to conduct active, future oriented research and development. Although there is specific mention of a number of research focuses, including developing transport solutions with lower environmental impacts and continually reducing products fuel consumption, no mention is made of research into environmental improvements for production systems. One statement that could be related to the continuous improvement of the chemical handling/management system is that the use of environmentally harmful materials should be reduced. Process chemicals are very clearly defined by Eskilstuna's EMS and VTEC's chemical assessment panel as environmentally harmful materials and so their use should be reduced also through technical improvements to that system.

The reduction in the use of harmful materials goes hand in hand with resource efficiency, the fourth principle of this policy. Volvo Group's products and processes should be designed and implemented in ways that reduce the consumption of energy and raw materials and minimise the generation of waste. Any improvements to the chemical handling/management system could be guided by this principle to reduce its consumption of chemical product and to minimise the amount of waste chemical product after use.

AB Volvo's environmental policy (Volvo, 2004a) clearly sets out a number of principles that could, and indeed should guide the continuous improvement of Eskilstuna's chemical handling/management system. Most importantly, it provides insight into the way that BP Castrol should be influenced by AB Volvo's environmental concerns. It can be argued that, on the grounds of this policy, BP Castrol should be included in the continuous improvement of Eskilstuna's chemical handling/management system. If they are required to adhere to the principles contained herein, they should also be given the opportunity to participate in all other aspects of the policy including technical development and working on resource efficiency.

Customer focus, leadership commitment, participation by everyone and a process culture are the four principles of the quality policy (Volvo, 2004b). Also approved in 2004, this policy clearly establishes a commitment to attaining excellence in quality with a focus on customer needs. The first principle places a clear emphasis on listening to customers and planning continuous and sustainable improvements based on their input. Although there may not be a customer demand to improve the performance, environmental or otherwise, of the chemical handling/management system at Eskilstuna, customers do demand that companies, in general, improve their environmental performance. This pressure is normally placed on the company through legislation and this is the case with the Volvo Group.

According to the quality policy, all quality improving actions should be quantifiable, measurable and deliverable. In addition, authority and responsibility should be delegated as much as possible. It could be argued that delegation of authority and responsibility fits in with the approaches of lean production's team organisation. By conducting continuous improvement work that involves all employees in teams, responsibility and authority is delegated to many individuals. This idea fits very closely with the third principle, participation by everyone, of the quality policy. This principle determines that all Volvo personnel, and the personnel of suppliers, should have a well informed and consistent view of the objectives and should actively contribute in cooperation with others. A very clear directive is established to conduct work in such a way that suppliers are closely related, to the point of complete inclusion, in the actions of Volvo companies.

The fourth principle establishes that all processes should be identified, documented and continuously improved. To do this Volvo should work towards achieving maximum customer value and zero defects and through establishing, working towards and monitoring the results against measurable process objectives. The intention of this principle is to establish a culture of process awareness within Volvo. By focusing on improving the quality of processes, perhaps Volvo hope also to improve the quality of their products and services. In light of this, major opportunities exist to minimise the impacts of process chemical use by establishing specific goals for chemical variety, hazard level and use reduction. By establishing specific targets and monitoring progress, the process of chemical handling/management can be continuously improved.

When discussing the definition of continuous improvement with interviewees it was apparent that this term was not clearly defined in the sense that it is not clear what types of improvement it might include. The improvement must be something that can be measured with data in order to prove that the action really was an improvement. According to this description, improvements of the chemical handling/management system at Eskilstuna are definitely covered under the scope of continuous improvement.

It is clear that a strong commitment from AB Volvo exists through application of the corporate policies relating to the core values of the company; environment, quality and safety. While the policies are being effectively delivered to the business area level, one interviewee revealed that managers are perhaps not converting these policies into their own strategies or goals. The environmental and quality policies outline a number of principles that support the notion that the chemical handling/management system at Eskilstuna should be continuously improved, that this work should be conducted by teams and that BP Castrol should be involved in this improvement work.

4.2.3 Strategic Objectives

Strategic objectives guide all of Volvo's activities towards the 2015 wanted position (as outlined in Section 2.2). The current strategic period is 2007-2009 and its objectives focus on three areas; improved customer focus, value and satisfaction, to achieve profitable growth, product cycle management and operational excellence (Volvo, 2007c). While the objectives within profitable growth and product cycle are important, they are not so relevant when considering the chemical handling/management system at Eskilstuna. However, operational excellence is clearly important as its three sub goals include increasing productivity and cost efficiency, developing competence and leadership and driving mastery in execution (Volvo, 2007c). These strategic goals are adapted by each BA/BU to make them applicable to the operations of that area. In order to see how these goals are related to Eskilstuna it is necessary to look at the strategic goals set out by VCE.

As with the AB Volvo strategic objectives, VCE's strategic objectives are categorised under three headings; profitable growth, product cycle management and operational excellence (Volvo, 2007b). The theme of these objectives is very much focused on the forthcoming increases in production and sales that this will involve. For example, profitable growth refers to the need for growth to be profitable not only an increase in production volumes. Product cycle management aims to deliver what the customer needs and to enhance both soft and hard product lines. More importantly, in relation to the Eskilstuna case, operational excellence focuses on working more efficiently, reducing costs, utilising resources more intelligently and building the support, loyalty and commitment of employees (Volvo, 2007b). In light of these objectives, chemical handling/management system improvements clearly address the goals of improving efficiency and reducing costs. In addition, if these changes were to take place within the VPS framework, and conducted in a team environment, employees support, loyalty and commitment would be enhanced.

4.2.4 Volvo Production System

Achieving operational excellence, one of AB Volvo's strategic goals, is the purpose of the VPS. This system has been in development since 2004 after it was decided that a new Group-wide method of work needed to be developed that would result in improved performance. One interviewee revealed that it was determined that the new approach to work should be centred on updating the production system first, as it was the most well discussed area and because it presented the most opportunities for improvements. This section outlines the VPS and discusses its applicability in acting to drive improvement of Eskilstuna's chemical handling/management system via engagement with the CMS provider. This section extensively references an unpublished internal document titled *VPS – Training module overview (Volvo, 2007e).*

Based on the very successful and well publicised Toyota Production System[3], the VPS is an integrated way of operating that links the corporate vision and guiding principles to standardised tools used for continuous improvement. It is a system that continuously evolves in a structured manner to ensure development and application of best practices designed to assist development activities. To better understand the role of the VPS it is also of use to consider that the system is *not* a set of standard operating procedures or compilation of best practices, is *not* a static system and is *not* a directive process intended to replace existing management or business systems.

[3] For further information on the Toyota Production System please see *The Machine that Changed the World (Womack, Jones, & Roos, 1991).*

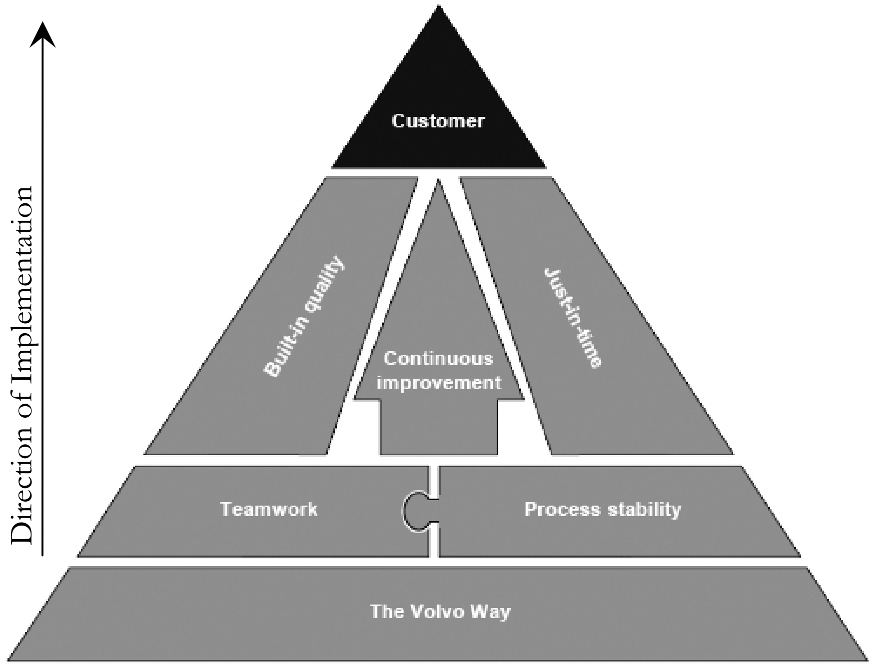


Figure 4-11 Volvo Production System Overview (Volvo, 2007d)

Continuously creating value for customers, in an effort to become the world's leading provider of commercial transport solutions, is the aim of the VPS (Figure 4-11). This aim is categorised at the head of the model as 'Customer' (note the direction of implementation of the model such that the end point is the Customer). In order to achieve this aim, the actions of Volvo should be built on a solid foundation. This foundation is provided by the vision, mission and values that make up the culture of the company, as outlined in The Volvo Way (Volvo, 2004c). Five principles; teamwork, process stability, built in quality, JIT and continuous improvement, form the body of the model and built in quality and JIT must be implemented and achieved simultaneously for the system to be successful. If one of these principles is not implemented correctly, the system will collapse. If all these principles are implemented and maintained correctly, operational excellence will be achieved. At its core, continuous improvement drives the entire change in the production system.

A considerable amount of attention was paid to understanding this system as it became apparent that, since improvement of the chemical handling/management system clearly constitutes development towards operational excellence, any actions taken should fit within the model of the VPS. Analysis of this model was conducted to evaluate whether actions taken to continuously improve the chemical handling/management system, and the resulting relations between VCE CMP, VTEC, NAP and BP Castrol, would be affected by, would affect or should occur within the VPS model. Early reviews of the system revealed that one of its central elements, teamwork, clearly fitted with principles of continuous improvement (such as Six Sigma, lean production and so on) and also presented a possible solution to the organisational issues surrounding the relations between VCE, VTEC, NAP and BP Castrol. It should be noted that this research is not intended to be an evaluation of the VPS compared with other lean production systems but, rather, an assessment of its capacity to deliver answers regarding the way to conduct continuous improvement of the chemical handling/management system at Eskilstuna. In order to do this, it is necessary to consider the model in some more detail.

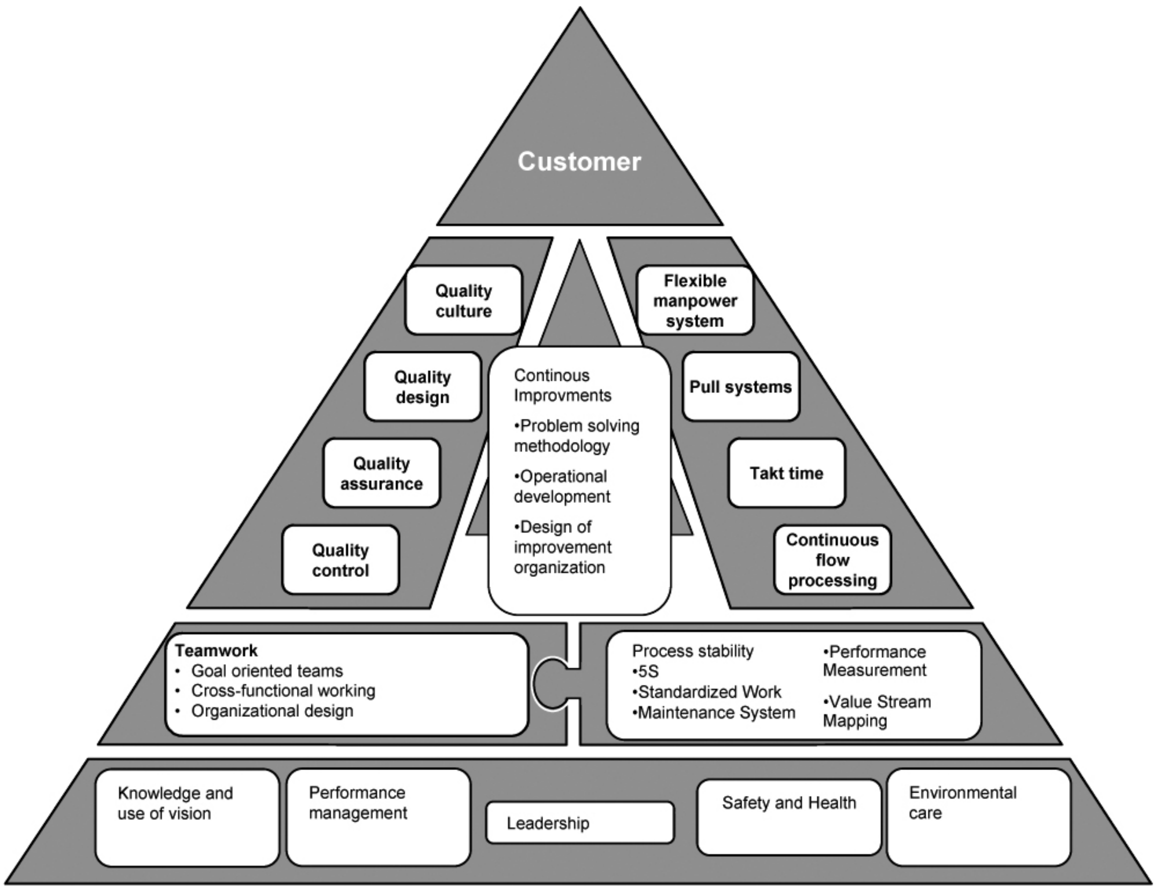


Figure 4-12 Volvo Production System in Detail (Volvo, 2007f)

A number of sub elements exist within each principle, as shown in Figure 4-12. It is not necessary to consider each of these principles here; however, it is acknowledged that an understanding of all of these principles assists in understanding the relationships between all of these elements[4]. It suffices to say that there are many co-dependencies between model elements that create a very strong model for achieving the desired goals. A number of these elements are now considered in further detail based on their relation to the chemical handling/management system at Eskilstuna:

- Goal oriented teams,
- Organisational design,
- Maintenance system,
- Quality design,
- Problem solving methodology,
- Operational development and,
- Design of improvement organisation.

[4] Because the VPS is still in development, further information is not available to Volvo personnel let alone the general public.

Goal Oriented Teams

Implementation and success of the VPS begins with teamwork. In line with continuous improvement methodologies, goal oriented teams form the organisation of choice for conducting work within the VPS model. As with OD, Six Sigma and lean methods, team organisation is used to involve all personnel in conducting improvement activities and distribute responsibility and ownership to every member of the team. Goal oriented teams ensure that the individuals' and teams' goals are in line with the goals of the entire organisation. This ensures a stable and regular organisation from which performance can be monitored. These teams are designed to conduct improvement activities that address long term health and short term performance, to communicate expectations set individual performance objectives and give individuals the opportunity to develop. These teams are, therefore, not only about improving performance of systems, but also the performance of individuals. By involving all and distributing ownership to individuals, every person can feel that they are contributing positively to the organisation. The teams' tasks include establishing targets, identifying accountabilities and setting KPIs, creating realistic plans, tracking performance, reporting performance and rewarding positive actions.

Organisational Design

In addition to employing goal oriented teams as the organisation of choice, the VPS focuses on ensuring that the organisation is designed in the most effective and efficient way, from the bottom up, to fit the needs of the value stream. Changes to the organisational structure should be designed such that the span of control for team leaders, supervisors, managers and so on is appropriate for the complexity of the process. Roles and responsibilities should be clearly defined and the level of involvement of support functions, such as maintenance, logistics and so on, should be determined. Attention should also be paid to how the organisation is designed to meet the needs of external suppliers and support functions. Once the organisational design has been determined, methods of reporting should be identified.

It is the design for the requirements of external suppliers that is of most significance here. This tool indicates that Volvo Group companies should try to modify their own organisation in order to fit in with the requirements of other actors. Considering the situation presented at Eskilstuna, where a key external supplier exists, it could be argued that this section of the module clearly states that Eskilstuna's organisation should be designed in such a way that BP Castrol's needs are met. It would have to be determined exactly what those needs might be. An alternate perspective might be to consider what BP Castrol could do to be receptive to Volvo's needs. It is clear that the intention of the contract for provision of chemical management services is for BP Castrol to act in ways that support the actions of VCE CMP. For example, BP Castrol supplies chemical products that ensure that machining quality is maximised. It would surely be a positive step towards mutual benefits if VCE CMP ensured that their organisation was such that BP Castrol's actions to enhance performance could be more effectively and efficiently conducted.

Maintenance Systems

To ensure process stability, one of its five elements involves the maintenance systems. Correctly identified as a major factor in achieving continuous improvement, this module aligns the maintenance actions with those presented by the TPM approach. Table 4-2 shows the presence of most of the TPM elements within the VPS model. Although the VPS documentation for this module doesn't include the elimination of waste, this goal is achieved through the full implementation of the VPS. Scheduled maintenance is not explicitly mentioned. However, it seems that this module's concern is for ensuring that all equipment is operating optimally. In order to achieve this, scheduled maintenance should be carried out anyway.

Table 4-2 Presence of TPM in VPS

TPM Approach	VPS Presence
Improving OEE	Yes
Eliminating waste (see Lean Prod.)	Elsewhere in the system
Scheduled Maintenance	Not explicit
Autonomous maintenance	Yes
Training machine operators	Yes
Maintenance prevention	Yes

One aspect of the maintenance system that could relate to Eskilstuna's chemical handling/management system is that new equipment should be maintenance free. While this does not necessarily assist in achieving continuous improvement, it does address the case presented where an opportunity to conduct a one off upgrade exists (such as that presented by CS09). With this in mind, the chemical handling/management system should, theoretically, be designed such that it is maintenance free. This might alleviate the need to continuously improve it. By designing a highly effective and efficient system now, there may not be a need to improve it in any way for a significant period of time. However, this may also create the problem of technology lock in. If a better design becomes available at some later date, the investment in the existing system may prevent Volvo from pursuing further improvements.

Quality Design

Quality design is one of the focuses of the 'built in quality' principle. In addition to quality assurance, control and culture, quality design ensures that quality is factored into the design of products and processes. Quality design is intended to expand the focus of building in quality to include suppliers' development processes. BP Castrol's efforts to develop and improve its products and processes should, therefore, also be considered VCE CMP's concern. The design of Eskilstuna's chemical handling/management system should also aim to create a system that builds in quality. With this goal in mind, the question regarding how this relationship should be structured is highlighted. Although this element focuses more on the design of products, it highlights that suppliers should be involved in the design process to prevent quality problems being built into the system. This confirms the idea that BP Castrol should be involved with the design of the chemical handling/management system at Eskilstuna, since they are the supplier that contributes to the operation of that system.

Problem Solving Methodology

The fifth principle, continuous improvement, contains three elements; problem solving methodology, operational development and design of improvement organisation. Problem solving methodology sets out which processes and tools Volvo should use to solve problems. The intention is that by teaching everyone in the organisation how to solve problems, everyone can contribute to continuous improvement. The processes for problem solving are the DMAIC cycle, drawn from Six Sigma, and PDCA, as drawn from Kaizen, ISO 14001:2004 and ISO 9001:2000.

Operational Development

A clear link exists between OD and the VPS. As described in Section 4.2.11, OD is a business model for continuous improvement centred on teamwork. Operational development, within the VPS, is the mechanism used to manage the generation of ideas for improvements and how that fits into daily work. It is intended to drive and implement improvement activities on a number of different levels. These levels include daily improvements on the factory floor, as initiated by operators, systematic improvements, as a result of teams meeting regularly and management driven strategic changes. With regard to the Eskilstuna case, it seems that continuous improvement of the chemical handling/management system would, most likely, be work for an OD team. Daily, factory floor changes are the responsibility of the BP Castrol on site staff, but, more detailed changes are more likely to be achieved within the forum of an OD team.

Design of Improvement Organisation

Continuous improvement is bolstered by the design of improvement organisation module. This module outlines the factors that should be considered when the organisational structure is being designed. Factors to consider include the roles and responsibilities that are necessary to conduct improvement work, the skills and capabilities that are necessary and the structure and size of the organisation at corporate, plant and line level. The intention is that these guidance tools help to build an organisation where continuous improvement is a part of the daily work to generate and implement improvement. In light of this support module it is apparent that significant attention is paid to the way in which the organisation for continuous improvement should be designed.

The VPS aims to achieve operational excellence through implementing lean production thinking to create a consistent production system across all Volvo Group companies. At its core, the VPS uses continuous improvement to continuously upgrade the performance of all elements of the Volvo Group's operations. The Eskilstuna case includes two types of improvement. The first is a step change, where a one off opportunity to upgrade the system (as with the CS09) could result in a radical improvement in the design of the chemical handling/management system. The second involves the continuous improvement of that system. It appears that both types of changes should be handled within the VPS framework. Under the OD aspect of the VPS both step changes and systemic, daily improvements should be part of the production system. The maintenance team should be involved, since their role in the VPS is of significance. Finally, the design of teams, and other organisational elements, is clearly within the framework of the VPS. Together, these elements provide a framework within which the problems faced at Eskilstuna can begin to be addressed.

4.2.5 Business Management System

AB Volvo is currently in the process of introducing a new BMS throughout all Volvo Group companies. This system will integrate the EMS and QMS. The integration of these systems will no doubt improve the effectiveness and efficiency of the implementation of both systems. However, since this system is not currently in place, its impact on the current situation was not considered.

4.2.6 EMS ISO 14001:2004

Eskilstuna and BP Castrol are both certified according to ISO 14001:2004 for their environmental management systems. This raised a number of interesting questions regarding the ways in which these systems interacted with each other in light of the CMS contract. While BP Castrol's certification covers all of its products and services, including those conducted on-site at Eskilstuna, it was not clear how Eskilstuna's certification affects the actions of BP Castrol on-site. It is clear that whatever actions BP Castrol take, they must be in compliance with Eskilstuna's EMS and legally, Eskilstuna is liable for BP Castrol's activities on site. It was also pointed out that BP Castrol should be covered in any audit of Eskilstuna and/or of BP Castrol. However, it could be assumed that their activities may fall outside of most audits due to the potentially complex nature of their interaction. One interviewee revealed that it was likely that BP Castrol was in compliance with Eskilstuna's EMS due to the legal liability held by Eskilstuna.

As pointed out in Section 3.5.1, the basis of an ISO certified EMS is the PDCA cycle. A very clear focus on that cycle is, in light of their certification, in place at both Eskilstuna and BP Castrol. It could be argued that both organisations are well practiced in using this cycle of conducting improvement work.

4.2.7 QMS ISO 9001:2000

Product and process quality at Eskilstuna are closely monitored and controlled by an ISO 9001:2000 system for quality assurance. Quality control, using this standard, is also an element within the VPS. In that system, the ISO 9000 series, and its comparative systems around the world, are the basis for ensuring the quality of products and processes. Quality assurance is related to the continuous improvement of the chemical handling/management system at Eskilstuna in that any changes made to that system should occur within the quality requirements for process changes within the ISO 9001 framework. In isolation, this standard is of less importance to the continuous improvement of Eskilstuna's chemical handling/management system. However, when considered as part of the VPS and as part of an integrated BMS (as indicated will be the case in future), it becomes a stronger system for conducting PDCA based work and continually improving processes and products.

It should also be acknowledged that BP Castrol's actions on site are covered by their own quality management system (ISO 9001:2000) but that this system is not integrated with their EMS.

4.2.8 Global Development Process

The Global Development Process (GDP) is a decision making model based on common values and a common tool box. Its primary focus is the delivery of the right product and soft offering with the right quality, at the right time, with the right cost and risk levels and with features that meet or exceed customer expectations (Volvo, 2006a). Within such a large organisation as Volvo, where a number of different companies are all performing product development, there was a need to develop a common way to execute projects in a structured way and so the GDP was developed (Volvo, 2006a).

The system is essentially a framework for decision making that has been developed by Key Technology Committee Methods (KTC Methods) within GIB Technology. The framework consists of general descriptions, roles and definitions for decisions, steering committees and projects and tools and processes for project management. At Volvo corporate level (AB Volvo), the system is presented in its most generalised form. However, the process should be developed within each BA/BU as determined within the requirements of the framework.

The process is built around Gates and Decision Points (as shown in Figure 4-13 below) where decisions are made by a number of decision bodies and project managers. Gates are used to determine whether the criteria for the phase have been met and whether or not the project can proceed (Volvo, 2006a). Decision points are used to approve or reject a project and approve or reject project funding for the next phase.

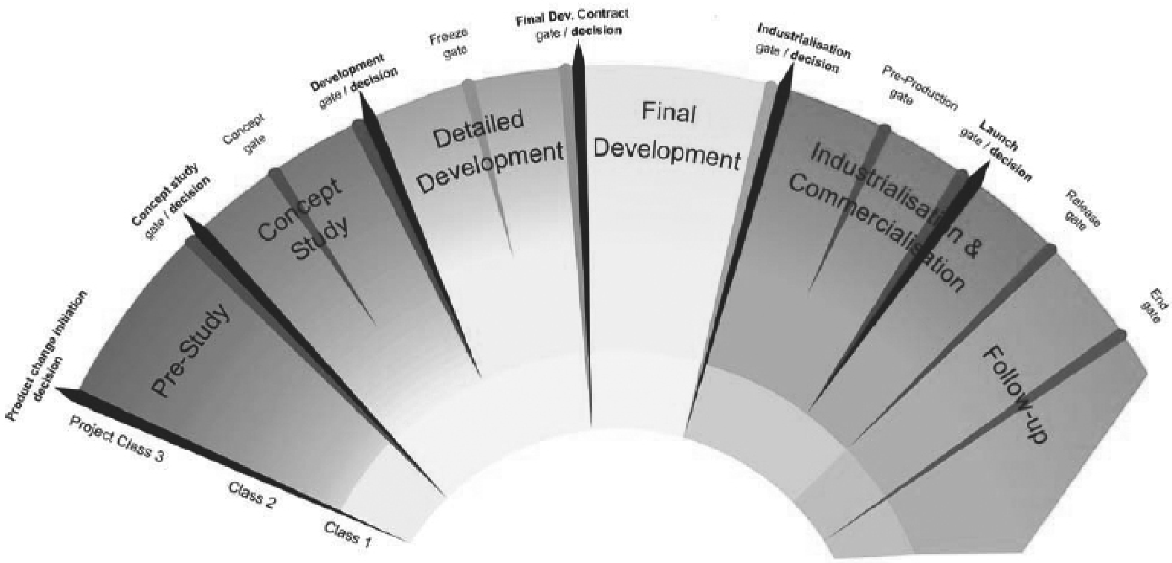


Figure 4-13 Global Development Process Model (Volvo, 2006a)

This system could be used to implement large projects where, for example, the chemical handling/management systems infrastructure is dramatically altered. However, the focus of the GDP is not on performing small continuous improvement, such as those within a lean production approach. It could be argued that this decision making process could be used to implement larger projects but it's clearly not applicable for daily improvements.

4.2.9 Chemical Assessment

It is important to consider the chemical assessment function within Volvo to determine what role it plays, or could play, in affecting the continuous improvement of the chemical handling/management system at Eskilstuna. Chemical assessment is typically the domain of environment, health and safety personnel but in the Volvo Case, where there are significant quantities of chemical product being used, chemical assessment has become a core competence of VTEC.

Chemical assessment, as a core function of VTEC, involves the classification of all chemicals used, in sufficient quantity[5], within Volvo Group companies. The task of the chemical assessments group, within VTEC's Environment and Chemistry unit, is to conduct the relevant testing and classification of chemical products for entrance into a central database called MOTIV. The process can vary slightly depending on who orders the classification, but the most common procedure is presented here.

[5] One interviewee revealed that not all chemicals are classified using this system as the quantity of use is very minor. For example, only production quantity chemicals are classified in this way whereas one off chemical products are not. It is not entirely clear where the quantity limit is set. In any case, it is not of importance for this research.

Typically, a worksite will ask VTEC to conduct a chemical assessment when there's a need to introduce a new chemical product into production, or into the product itself. This request may come from purchasing, environmental representatives or others working with chemical products. However, it is most often the case that this request comes from a representative of the health and safety department. VTEC's role is then to check the manufacturer's classification of the product to be used. In order to check this classification VTEC must obtain detailed information from the products manufacturer including safety data sheets and often the make-up of the chemical product. Interviews revealed that this information is sometimes very difficult to obtain. This is understandable considering that the exact formulas for chemical products are highly sensitive and often patented information. To deal with this problem, VTEC often enters into confidentiality agreements with its chemical suppliers. Once material safety data sheets and detailed product information is obtained VTEC checks that the classification given by the manufacturer is correct, in line with a number of internal and external chemical regulations, and if need be, alters the classification appropriately. Once this is done, the information about the chemical product is added to different pages of MOTIV.

MOTIV is a central database of chemical classifications that is contained on the Volvo intranet. Its pages can be accessed by all within Volvo with some users having password access so that they can make changes to the database, such as updating information. In addition, key personnel, mostly in the environmental organisation, have special access to enable the editing and printing of Volvo safety data sheets for site use. Every chemical entry has the most recent version of its safety data sheet logged in the database. These documents are used to convey chemical assessment information to personnel within Volvo. The database is searchable by facility, product, whether or not the product is in use and other criteria.

After the central assessment is completed by VTEC, and the chemical product classified and entered into MOTIV, it is then the responsibility of the local department, the department that made the initial request, to conduct the final assessment of the product. Typically, it is a local health and safety department that has made the initial request and so will now conduct final assessment. This local group is familiar with the way in which the product will be used and so is better qualified to make final assessments regarding risk management. Once this final assessment is complete, and the product passed for use, authorised individuals can print the product's safety data sheet for inclusion in the appropriate EMS documentation and distribution throughout the worksite as required.

At Eskilstuna, two key positions, the environmental coordinator and a health department work-environment engineer, have outsourced chemical assessment to VTEC. The final local assessments are typically conducted by the health department work-environment engineer and that individual or the environmental coordinator then accesses the information through MOTIV to print the necessary safety data sheets.

Another important function performed by the VTEC chemical assessment group is keeping track of chemical related legislation. This group is always on the lookout for new legislation and are particularly perceptive of when a chemical substance may become a problem. To deal with the ever increasing restrictions on substances, one interviewee revealed that VTEC's assessment procedure is stricter than required by legislation. It is not clear if this predictive information is passed to BP Castrol to allow them time to make changes ahead of legislation changes. Despite this, it appears that BP Castrol is aware of Volvo's active work in chemical assessments, pushing BP Castrol to develop its products in line with the chemical classifications conducted by VTEC. One interviewee confirmed that VTEC's chemical assessments are a key driver for product selection and design.

Substitution projects (Substitutionprojekts) exist within the Volvo Group and are typically carried out by those working with environmental issues, aiming to replace the use of one chemical product with another. These projects can focus on chemicals used in a product but also in processes within production sites. Within MOTIV there is a database section[6] where project personnel can report the results of a substitution project as a way of logging their experiences such that others can learn from their work. One interviewee revealed that this system is used far too little, suggesting that perhaps it is not yet well known. Of course, the problem is that personnel will not look to this system for information while it does not contain any. The success of such a system requires that all projects of this nature report results compulsorily in the system. BP Castrol, VTEC and VCE CMP revealed that they had not used the system very much, and in some cases were not aware of this system. However, the information recorded in this database may be useful for providing previous experience and/or recording the experience obtained through conducting substitution projects as part of the continuous improvement work at Eskilstuna.

4.2.10 Black and Grey Lists

Part of VTEC's work involves actively engaging in chemical assessments resulting in the classification of chemicals into Black and Grey Lists (Volvo Standards 100-0002 and 100-0003 respectively). The Black List contains a list of chemical substances that cannot be used in the products or processes of Volvo Group companies and that should be phased out immediately. The Grey List is a list of chemical substances that should be phased out of use from Volvo Group products and processes as soon as technically and economically possible. These chemical assessments are viewed by BP Castrol to be ahead of current legislation on hazardous chemicals and, as one interviewee revealed, help to drive BP Castrol's product selection and development. The importance of these lists will be referred to in Section 4.2.12.

4.2.11 Operational Development

At a corporate level, AB Volvo recommends using the Operational Development (OD) model as a means of converting the words put forward by AB Volvo into action (Volvo). OD is a process built on five fundamental elements; a living process, setting the direction, work structure, team work and OD support. These elements are designed as an integral part of the management model to result in a work structure that involves everyone in improving the company (Volvo). Like the PDCA and DMAIC models, this process also performs the basic functions of identifying an area for improvement, determining what actions are required to rectify or improve a situation, undertaking those actions and evaluating the results. The similarities and differences are outlined in Figure 4-14.

Similarities can be drawn between the 'define', 'measure' and 'analyse' functions of DMAIC, the 'plan' phase of PDCA and 'direction setting' of the Living Process. These phases are all focused on establishing what needs to be done and how to do it. However the Living Process of OD is different in that the 'energy' phase occurs before 'direction setting'. Documentation review revealed that this step "…arouses energy by explaining why something needs to be done and makes the connection between the leaders own working group and the business situation…" (Volvo). The strength of this energy phase in contributing to the development process is not clear, and was not the subject of this investigation, but it could be considered as part of the planning stages of development. There may be potential to use this method to

[6] Available on the MOTIV website under "Substitutionprojekt inom Volvo."

create enthusiasm for environmentally based improvements to the chemical handling/ management system at Eskilstuna.

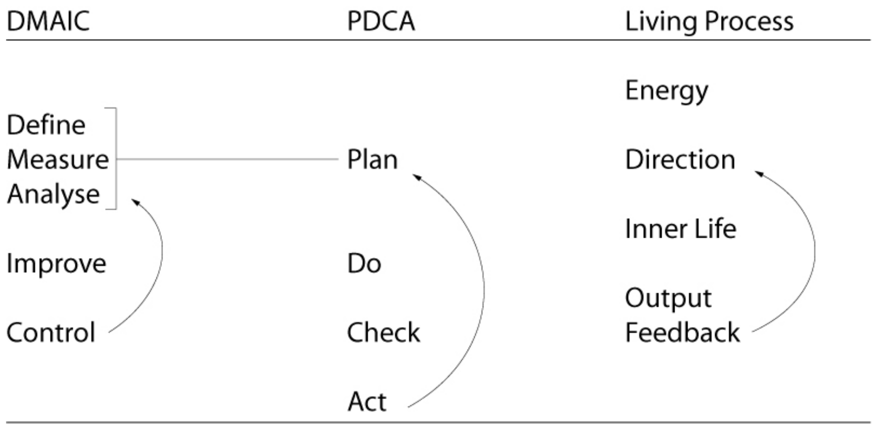


Figure 4-14 DMAIC, PDCA and Living Process compared

While DMAIC and PDCA provide a phase that focuses on taking action, 'improve' and 'do' respectively, the Living Process does not provide such a phase. Instead, the focus is placed on the 'inner life' of the team and the 'output'. It appears that these phases fit in before and after the 'doing' phase of the PDCA cycle. 'Inner life' refers to the OD teams capacity to learn from each other and to bring out every participants best by interacting with respect, trust and interest (Volvo). The 'output' phase refers to ticking off actions and creating new items for the action plan. It's purpose is to provide evidence that actions have been taken (Volvo). While there is no clearly defined phase of action, the role of the Output phase in ticking off actions indicates that actions should be taken.

In terms of evaluating whether the actions taken have been effective, all three approaches include a phase centred on measuring results; 'control', 'check' and 'feedback'. Each of these phases could be based on measuring performance against key performance indicators but do not have to be conducted in this way. The Living Processes approach is focused less on measuring performance and more on learning through reflection on performance and identifying how to improve their work and cooperation (Volvo). While this focus is not dependant on numbers, it is clear that key performance indicators are still used to measure success. For example, VCE's Wheel loader production at Arvika undertook OD and increased production from approximately 2300 to 5900 units over a period of five years while, at the same time, systematically decreased the total number of faults (Volvo).What can be seen from this example is that OD's use is not only limited to the development of business functions such as management and operations. It can also be used for the development of processes in the factory. Within the VPS framework there may be a possibility to utilise the structure presented here to conduct improvement work.

Within VCE the Customer Support Division owns the OD process. This system of development includes eight support groups consisting of between five and ten individuals representing different work areas within VCE. Each of these eight groups reports to one program owner. This system is global and includes all VCE's operating sites around the world. To give a picture of the breadth of representations, there is one representative from Eskilstuna's Component Division (sits in Group 6). Two interviewees, representing different aspects of Eskilstuna's operations, revealed that they were not aware of OD use at their site but did suggest that perhaps improvement groups were fulfilling the same function under a different system name. In any case, the existence of teams for carrying out improvement work already exists at Eskilstuna. The advantages gained by conducting this work under the banner of OD are not clear but may include improving commonality across the Group.

4.2.12 Environmental Requirements for Production Facilities

The Environmental Council, within AB Volvo, has released a document entitled "Environmental requirements for production sites and other operating units within the Volvo group" (Volvo, 2003). This document is a requirement for all Volvo Group companies, acting as an instrument to achieve the goals of the environmental policy. In order to achieve the goals set out in the environmental policy the requirements placed on production sites represent the minimum level of performance of selected parameters (Volvo, 2003). It is acknowledged that large variation exists between production sites; hence, the focus falls on minimum performance levels for the most common parameters. One goal of this document is to harmonise performance and to establish a wanted position towards which environmental actions can be directed. The document contains seven parameters, three of which relate to the use of chemicals.

Firstly, section 1.4 stipulates that chemicals classified on the Black List (Volvo Standard 100-0002) must not be used or must be phased out as soon as possible. Phase out plans must contain a deadline (Volvo, 2003). Chemical products listed on the Grey List (Volvo Standard 100-0003) must be monitored and less hazardous alternatives introduced when technically and economically feasible (Volvo, 2003). As a minimum, programmes for surveillance and active replacement of hazardous substances must be implemented. These requirements provide a very strong driver for the continuous improvement of the chemical handling/management system at Eskilstuna. Continuous improvement work could include altering the products used within this system. Such changes may lead to minor alterations in system infrastructure. In any case, as the provider of chemical products, BP Castrol clearly contributes to helping VCE CMP achieve these requirements at Eskilstuna. It is not clear whether the CMS contract between VCE CMP and BP Castrol outlines that BP Castrol should help to meet these requirements. However, interviews revealed that BP Castrol are well aware of the Black and Grey lists and work closely with VCE CMP to eliminate and substitute chemical products. One interviewee revealed that Volvo Group's Black and Grey lists help to define BP Castrols product formulations now, through product selection, and in the future, through product development. It was also noted that due to the dynamic nature of these chemical lists, the selection of products that BP Castrol can use within the plants was continuously decreasing, providing further drive to conduct development of alternate products and processes. On that note, another interviewee revealed that over the last twenty years, very few changes had occurred in the metal cutting industry, especially relating to the use of cutting fluids and coolants. The interviewee also noted that there is a relatively new move towards dry metal cutting. This technique could see the complete removal of the need for cutting fluids. Other fluids would still be required.

Volvo Group's 'wanted position' for chemical use is to maintain active programmes for the substitution of environmentally hazardous products with less hazardous alternatives and to reduce the amount of chemicals used per produced unit (Volvo, 2003). Again, there exists a very clear driver for continuous improvement work relating to chemical use at Eskilstuna. It is stressed that both of these programmes affect BP Castrol, as the supplier of chemical products within this system. It would not be possible to achieve either of these goals without the full support of BP Castrol.

Secondly, section 1.8 refers to waste management targets and stipulates that, as a minimum, measures should be developed and implemented to reduce waste and improve materials recycling (Volvo, 2003). Again, a clear driver exists for continuous improvement work. Any continuous improvement work undertaken by VCE CMP should aim to satisfy these goals. VTEC are already involved with projects in these areas demonstrating the active engagement in these issues. For example, VTEC are currently working on a project to identify and classify the different waste types at production facilities in an attempt to track waste movement and quantities. These projects are ongoing.

Thirdly, section 1.10 establishes the requirements for the organisational design to achieve the goals established in the document. Apart from establishing the organisational design, this section states that all new projects, concerning production or production related matters, must place environmental requirements in focus. Any future changes to the chemical handling/management system at Eskilstuna should be conducted with a focus on environmental requirements. As a minimum, all projects must include an environmental impact analysis (Volvo, 2003). In the case of Eskilstunas chemical handling/management, system this would ensure that any changes do not adversely affect the environment. However, it should also be noted that this would typically be carried out for larger projects, such as those conducted using a decision making model such as the GDP. Small, daily improvements would not require an environmental impact analysis. It could be argued, however, that a simple checklist could be used to make a simple assessment. In any case, the environment is placed, or at least should be placed at the centre of all continuous improvement work.

The environmental requirements placed on production sites provide very clear goals for the environmental performance of Eskilstuna. Most importantly a link between the Black and Grey lists and chemical use on site is established determining which chemical products can and cannot be used. This provides a driver for BP Castrol to continuously improve their products in line with the lists. Another driver is established by requiring production sites to minimise the quantity of chemical product used per produced unit. The contractual relationship places this requirement onto BP Castrol, requiring them to reduce chemical consumption. Despite this being a requirement, it works in BP Castrol's favour as any reduction in chemical use directly increases their profits.

4.2.13 Environmental Requirements for Suppliers

To ensure that the environmental work of Volvo extends to their major suppliers the requirements state that major suppliers must perform environmental self assessment and must implement the environmental requirements of the Volvo Group. These requirements are set out in the Environmental Self Assessment form, available through the supplier portal on the Volvo corporate website[7]. These requirements include a number of measures that ensure suppliers are acting within the bounds of a certified ISO or EMAS environmental management system and that a number of key environmental impacts are reduced. In accordance with an ISO or EMAS system, suppliers must be able to report on their environmental work, environmental organisation, fulfilment of legal demands and environmental results (NAP, 2007). With relation to chemical use, any chemicals or materials, delivered to Volvo in the form of products or services, must meet the requirements of the Black and Grey lists (NAP, 2007). It addition, suppliers shall consider recycled/recyclable materials when selecting materials and design solutions (NAP, 2007). In this case BP Castrol considers the use of renewable resources in its products and services. What can be seen is that these demands, coming from NAP and delivered to suppliers and service providers, place a

[7] http://www.volvo.com/NR/rdonlyres/EED541C5-52F4-43C9-BEAF 5E63004147B5/0/NAPEnvironmentalSelfAssessment.pdf

very strong impetus on improving suppliers' environmental performance. In working towards these goals suppliers are encouraged to maintain an open dialogue with Volvo, sharing their achievements and identifying possibilities for environmental improvements (NAP, 2007). The nature of the CMS contract at Eskilstuna is such that BP Castrol is economically benefited if they are able to identify areas of opportunity. In this case, BP Castrol does maintain an open dialogue with Volvo in working towards improved environmental performance.

By extending environmental requirements to the supplier network, Volvo effectively establishes environmental awareness and active participation in achieving company goals. BP Castrol is required to comply with the Black and Grey lists and must maintain an open dialogue with VCE Component Division.

4.3 Preliminary Conclusions for the Volvo Case

Analysis of findings revealed that a number of the theoretical elements for a successful model of engagement between a buyer and supplier towards continuous improvement, were present in the Volvo case. A summary of the presence of the theoretical elements within the Volvo case is provided in Table 4 (the theoretical attributes sources are shown in brackets and each aspect's presence in the Volvo case is judged as a strength or weakness).

Table 4-3 Presence of elements that could characterise a successful model of engagement, between a buyer and service provider working towards continuous improvement and sustainable development, in the Volvo case

Theoretical Attribute	Presence in the Volvo Case	Strength/ Weakness
Involve all employees (Kaizen, lean production, TPM, ISO 14001, ISO 9001)	• The VPS definition of continuous improvement mentions that all employees should be involved.	Strength
	• Environmental policy extends to all suppliers and business partners, of which BP Castrol is clearly one, indicating that they should also be involved.	Strength
	• Within the environmental policy, 'continual improvement' specifically notes the requirement for all employees to be involved.	Strength
	• Quality policy calls for the delegation of authority and responsibility to many, effectively involving all, or at least more, employees.	Strength
	• Participation of everyone is a principle of the quality policy.	Strength
	• The VPS establishes the use of teamwork to involve all employees.	Strength
	• OD encourages the involvement of all employees	Strength
Based on the PDCA cycle (Kaizen, lean production, ISO 14001, ISO 9001)	• The VPS definition of continuous improvement mentions that the process should be completed using the PDCA cycle placing it at the core of the VPS system.	Strength
	• According to the quality policy all processes should be identified, documented and continuously improved by establishing actions that are quantifiable, measurable and deliverable, carrying out these actions and monitoring the results against objectives – clearly the PDCA cycle.	Strength
	• VPS problem solving is based on the PDCA cycle.	Strength

	• Both Eskilstuna's and BP Castrol's ISO EMSs are built upon the PDCA cycle. • Quality certification based on the PDCA cycle. • OD's living process is similar, although not identical, to the PDCA cycle. • The environmental requirements placed on suppliers by NAP forces BP Castrol to be ISO 14001:2004 certified (they are anyway) ensuring their familiarity with the PDCA cycle.	Strength Strength Strength Strength
Based on team work (permanently formed teams) (Kaizen, Six Sigma, lean production, supplier integration, supplier development, 'closeness')	• Eskilstunas improvement groups resemble operational development teams but are not called that. • OD teams could work on continuous improvement but may not be permanent. • The CMS Board is a kind of permanent team for dealing with continuous improvement of the CMS. • Teamwork is one of the five principles of the VPS – specifically cross functional, goal-oriented teams. • OD work is centred on team structures. • OD teams are at the centre of the VPS for conducting improvement work.	Weakness Weakness Strength Strength Strength Strength
Goal – eliminating waste (Lean production, Six Sigma, ISO 14001)	• The environmental policy calls for reduced use of all harmful materials – one form of waste. • The environmental policy specifically aims to improve resource efficiency – the result of eliminating wastes. • EMS certification aims to eliminate wastes in various forms. • Aim of the QMS is to improve customer satisfaction – the lean approach to this is eliminating wastes and so waste elimination is also a focus of QMS. • The requirements for production facilities require that waste be reduced.	Strength Strength Strength Strength Strength
Maximising overall equipment efficiency (TPM)	• BP Castrol works with production and maintenance to improve the efficiency of machinery through improved process chemical use. • According to the maintenance system element, in the process stability principle of the VPS, all new equipment should be maintenance free, helping to maximise OEE.	Strength Strength
Culture of continuous improvement (Kaizen, lean production, ISO 14001, ISO 9001)	• BP Castrol works with production and maintenance to improve the efficiency of machinery through improved process chemical use. • Continuous improvement is the core of the VPS. • EMS certifications guarantee a commitment to continuous improvement. • QMS certifications guarantee a commitment to continuous improvement.	Strength Strength Strength Strength
Life cycle perspective (ISO 14001)	• The environmental policies 'holistic view' principle establishes a life-cycle perspective for products and processes.	Strength

	• EMS offers a life cycle perspective of the environmental impacts of processes.	Strength
Material substitution (ISO 14001)	• BP Castrol works with production and maintenance to improve the efficiency of machinery through improved process chemical use.	Strength
	• EMS encourages substitution of hazardous substances with less hazardous alternatives.	Strength
	• Substitutionprojekt section, within MOTIV, provides a forum for gathering information about previous experiences with chemical substitutions and recording new experiences, further encouraging substitutions.	Strength
	• The Black and Grey lists drive the substitution of hazardous chemical substances for less hazardous alternatives.	Strength
Joint problem solving (Supplier integration, operational knowledge transfer activities)	• Eskilstuna's improvement groups perform the function of joint problem solving with representatives from a number of functional areas.	Strength
	• BP Castrol and Volvo have worked together on joint problem solving – process fluid diagnosis.	Strength
	• The environmental policies technical development principle establishes a need for research and development – problem solving – although not necessarily *joint* problem solving.	Strength
	• Quality policy calls for the active contribution in cooperation with others indicating an element of joint work efforts.	Strength
	• VPS utilises cross functional teams suggesting an attempt to conduct joint problem solving.	Strength
	• The design of teams within the VPS establishes that Volvo Group companies should modify their own organisation to fit with the needs of other actors suggesting the possibility to conduct joint problem solving.	Strength
	• The quality design element, in the quality principle of the VPS, requires supplier involvement in process design.	Strength
	• The wanted position for chemical use is to reduce the amount of chemicals used per produced unit – this will surely require joint problem solving between VCE CMP and BP Castrol.	Strength
Long term commitment (Supplier integration, supplier development, operational knowledge transfer activities)	• NAP works to establish long term relationships with preferred suppliers.	Strength
	• The quality design element, in the quality principle of the VPS, requires supplier involvement in process design suggesting that this would allow BP Castrol to commit to a long term involvement with VCE CMP.	Strength
	• Since the Black and Grey lists drive BP Castrols product selection and development, BP Castrol is committing itself to a long-term relationship with VCE CMP.	Strength
Direct involvement (Supplier integration, supplier development, operational knowledge	• NAP views suppliers as an extension of Volvo.	Strength
	• Quality policy calls for close links with suppliers.	Strength

transfer activities, closeness, technological integration and innovation)	• The design of teams within the VPS establishes that Volvo Group companies should modify their own organisation to fit with the needs of other actors suggesting the possibility for direct involvement with supplier companies.	Strength
Close relationship (Supplier integration, supplier development, operational knowledge transfer activities, closeness, technological integration and innovation)	• Project work between BP Castrol and Volvo.	Strength
	• Within Eskilstuna, the production and maintenance departments work closely on solving technical problems relating to the CMS contract.	Strength
	• BP Castrol works with production to optimise performance.	Strength
	• The design of teams within the VPS establishes that Volvo Group companies should modify their own organisation to fit with the needs of other actors suggesting the possibility for building close relationships with service provision companies.	Strength
	• The wanted position for chemical use is to reduce the amount of chemicals used per produced unit. Due to the need to interact with BP Castrol the relationship between them, VCE CMP and VTEC will surely be strengthened.	Strength
	• The Black and Grey lists drive BP Castrols actions strengthening the commitment between VCE CMP, NAP, VTEC and BP Castrol.	Strength
	• The environmental requirements placed on suppliers by NAP encourage open dialogue between suppliers and Volvo Group companies.	Strength

It can be concluded that the Volvo case contains all the necessary elements to build a successful model of engagement between a buyer and service provider to work towards continuous improvement. The extensive references in Table 4-3 highlight the many actor and system elements that exist within Volvo Group and BP Castrol that could contribute to a successful engagement.

5 A Model of Engagement between VCE CMP and BP Castrol for Continuous Improvement

In response to the research questions, and in light of the preliminary conclusions presented in Section 4.3, this section outlines the proposed solution and recommendations and presents a generalised model for engaging service providers in continuous improvement. This section concludes the Volvo case. Conclusions, in response to the purpose, follow in Chapter 6.

5.1 Organisational Model of Engagement

The first research question was:

> *How should the actors and systems of Volvo and their chemical management service provider be organised to ensure continuous improvement of the chemical handling/management system at Eskilstuna?*

In response to this question, the following solution was proposed in the focus group at VTEC.

1. The experience of Eskilstuna's previous improvement groups should be harnessed by forming a team called the Chemical Improvement Team (CI Team). This group could be consolidated from a number of existing groups or could be a newly formed team.

2. This team membership would be devised according to the requirements of the 'Design for Improvement Organisation' module within the VPS and would include at minimum:

    a. **Environmental coordinator:** acting as a link between the environmental committee, maintenance, production and BP Castrol on-site. Environmental focus would be provided by this representative.

    b. **Quality representative:** provided by the production department. This representative is responsible for guiding the quality aspects of chemical improvement work, providing expertise in the technical aspects of the chemical handling/management systems infrastructure and conducting the physical work for system improvements.

    c. **Maintenance representative:** providing expertise in the technical aspects of the chemical handling/management systems infrastructure and conducting the physical work for system improvements.

    d. **BP Castrol on-site:** providing expertise on the use of chemicals and ways that chemical use can be further improved.

    e. **Local NAP representation:** acting as a relationship manager between BP Castrol and VCE CMP and ensuring any necessary contractual changes are made.

    f. **Additional expertise:** as required (could include global NAP and VTEC representatives or consultants).

3. This team would act on a local operational level, conducting daily work towards continuous improvement such as identifying opportunities, establishing goals, implementing actions and reporting results according to the PDCA cycle.

4. The CI Team would report regularly to the CMS Board.

5. The CMS Board would remain as an organisational element however its function would differ from its current state. It would now be tasked with approving projects based on their capacity to achieve the strategic objectives and to release funds when appropriate. This group would report regularly to VCE CMP production management and would remain as an advisory body to the CI team. This group would consist of members who represent VCE CMP's interests but not necessarily the interests of those involved with the CMS contract.

6. VTEC should maintain its position as advisor and consultant to BP Castrol and VCE CMP. If possible they should also provide guidance to the CI Team. Alternatively, they could provide guidance to a centrally located CI Team potentially situated in NAP.

7. NAP should retain its position as a contract negotiator and should maintain its roles as advisor to BP Castrol and VCE CMP.

8. BP Castrol off-site should work more closely with VTEC and NAP to establish strategic level continuous improvements.

This solution is consistent with the theoretical model where teams should form the basis of any engagement between buyers and service providers. Inline with the theoretical model, this engagement should create a close relationship between VCE CMP and BP Castrol allowing for joint problem solving, encouraging long term commitment and involving all in a process of continuous improvement based on the PDCA cycle.

This solution is shown graphically in Figure 5-1.

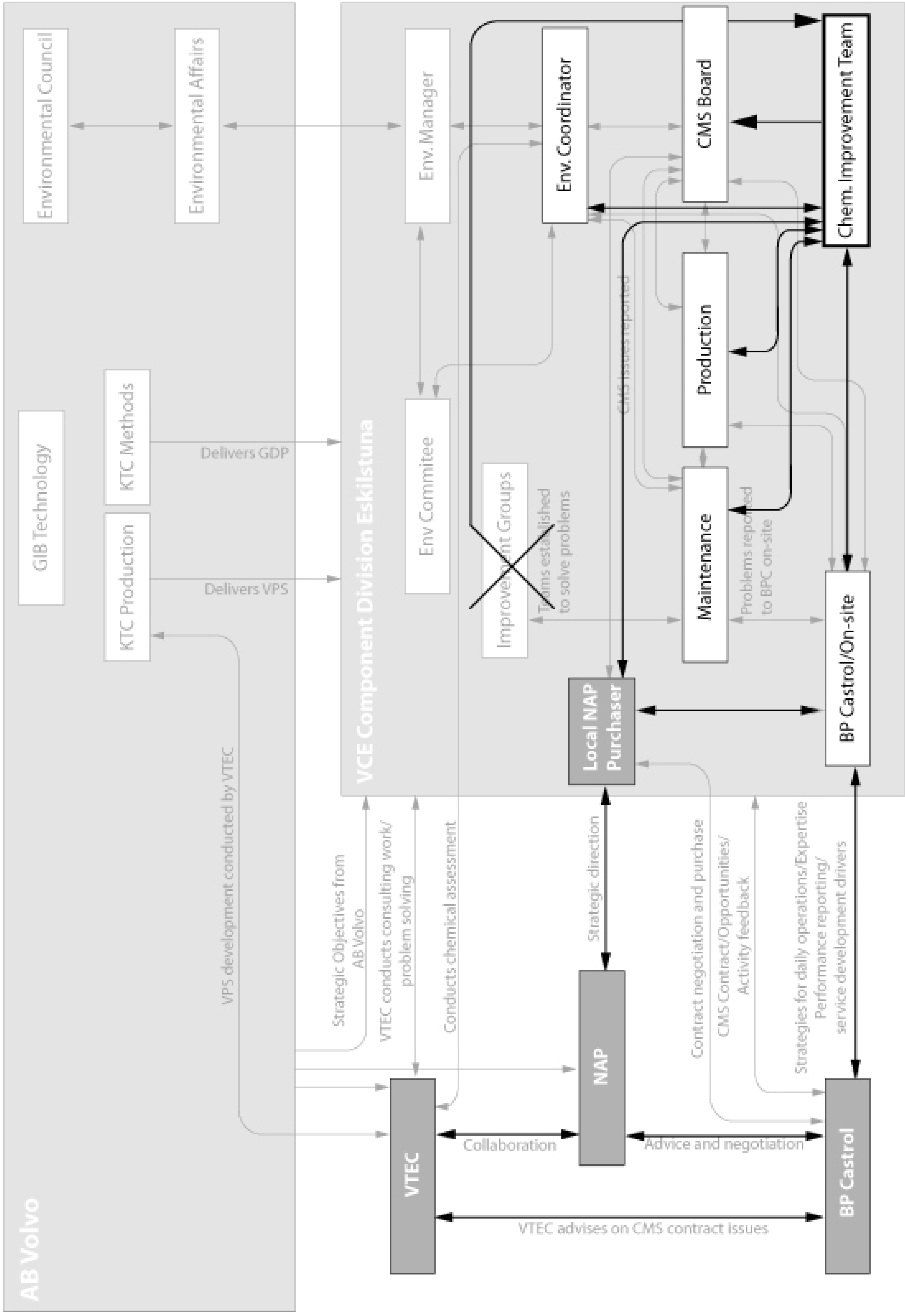


Figure 5-1 Organisation for engaging BP Castrol in continuous improvement work at Eskilstuna

5.2 Recommendations

Focus group discussion of the proposed solution resulted in a number of conclusions to the case being reached (for a full summary of the session please see Appendix I). The following recommendations were agreed:

- Management must commit to goals developed by lower level teams in accordance with the VPS and other relevant systems.

- Management must provide clear direction for continuous improvement by contributing to goal setting for continuous improvement and sustainable development.

- Continuous improvement actions should be taken in response to the environmental and quality policies.

- The definition of continuous improvement is not clear. A definition that is applicable across all ISO certifications, the VPS and existing improvement methodologies should be established.

- Continuous improvement work focuses on small daily improvements whereas the GDP focuses on completing large projects successfully. For this reason no link exists between the situation at Eskilstuna and the GDP, nor should one be created.

- The value of teamwork is well established even though it is not necessarily called operational development.

- Continuous improvement work should be conducted by a team in accordance with the ISO 14001:2004 certification under the umbrella of the VPS.

- A CI Team (or similar) could act in a permanent way by interacting regularly but not necessarily every day.

- The CI Team should contain representatives from the environmental (ISO 14001) and quality (ISO 9001) departments or, in future, a representative from the BMS department.

- The Substitutionprojekt page should be used to gather information regarding the experiences of BP Castrol in conducting substitution of chemical products.

- Reporting ideas for continuous improvement to the CMS Board works well. This link should be maintained.

- The CMS Board should remain in the model, although its function would change, and should act as a link between the CI Team and VCE CMP top management.

- The quality of improvement work could be improved, perhaps through BP Castrol providing Volvo with access to a wider knowledge and experience base, rather than only one BP Castrol representative.

- Conditions should exist that allow BP Castrol to work more closely with production on-site.

- Actions should be taken to allow BP Castrol to help Eskilstuna with substitution projects.
- The CMS contract should be owned and controlled by the Production Manager.
- Service suppliers could learn from the CMS contract regarding how to document continuous improvement work.
- Equal emphasis must be placed on continuous improvement work conducted for the benefit of the economy, society and environment.

5.3 Application of the Proposed Model to Other Cases

The second research question was:

> *In what ways would the solution differ, in order to make it applicable to other scenarios where services are provided?*

In response to this question, the possibility of creating a general model for continuous improvement work within service provision contracts was discussed during the focus group (for full results see Appendix I). The situations where such a model could be applied were also discussed and it was concluded that the proposed model for continuous improvement (see Figure 5-1) could be applied to other service provision contracts especially in the waste management area and the paint shop. While the exact implementation details would differ, depending on who should be represented, the general idea of having a team at the centre of continuous improvement work could be applied in other cases.

In an attempt to better communicate this to the Volvo Group, a simple, general model was developed to show the major organisational elements of such an engagement. This model is shown in Figure 5-2.

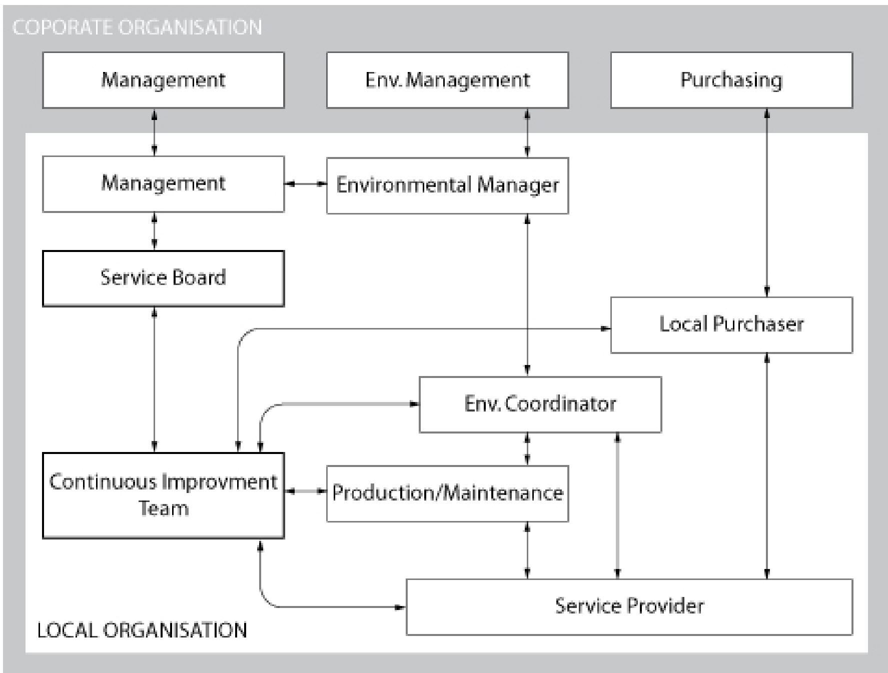


Figure 5-2 A General Model for engaging service providers in continuous improvement

In this model, the continuous improvement team would act on a local operational level, conducting daily work towards continuous improvement such as identifying opportunities, establishing goals, implementing actions and reporting results according to the PDCA cycle.

The improvement board would approve projects based on their capacity to achieve the strategic objectives and would release funds when appropriate. This group would report regularly to the appropriate management and would act as an advisory body to the continuous improvement team

Production and maintenance functions would provide expertise as required and would also provide guidance on the quality perspective of improvement work.

The environmental coordinator would ensure that the improvement work is in line with the requirements of the EMS and the Volvo Group's environmental objectives.

Finally, a local purchaser would act as the negotiator between the local company and the service provider.

6 Engaging Service Providers in Continuous Improvement and Sustainable Development

The purpose of this research was to build an understanding of how a large business engages its service providers in continuous improvement. Of particular interest was the interaction between business approaches to continuously improving and sustainably developing manufacturing processes in the case where a service provision contract existed between a buyer and supplier. In order to gain detailed knowledge of this interaction a case study at Volvo Construction Equipment's Component Division (VCE CMP), Eskilstuna, was conducted.

This research discovered the ways in which business organisation approach sustainable development and sustainable business. It then introduced approaches to continuous improvement, product service systems, environmental management systems (ISO 14001), integrated management systems and buyer-supplier relationships. A theoretical model for successful engagement between a buyer and service provider working towards continuous improvement was then developed. This model then served as a point of reference for the analysis of Volvo Group's actors and systems, to assess the way in which VCE CMP should engage with BP Castrol to work towards continuous improvement of the chemical handling/management system at Eskilstuna. Analysis revealed that VCE CMP, BP Castrol and other key actors including environmental functions, Volvo Technology (VTEC) and Volvo Non-Automotive Purchasing (NAP), contained the necessary actors to successfully engage BP Castrol. In addition, the Volvo Production System (VPS), VCE CMP's environmental and quality certifications and operational development approach, provided systems within which this engagement and improvement work could be undertaken. A solution was proposed and agreed upon by VCE CMP, VTEC and NAP representatives at a focus group concluding the Volvo case study.

The Volvo case highlights the real world systems that can be used to characterise a theoretical model of engagement between a buyer and service provider working towards continuous improvement and sustainable development. To conclude:

- Continuous improvement work can theoretically be carried out by teams working within an EMS and in conjunction with a lean manufacturing style production system.

- One definition of continuous improvement must be clearly established and communicated to all relevant actors in both the buyer and supplier companies.

- Companies should not duplicate improvement systems.

- Service providers must be empowered to contribute to improvement projects at the buyer organisation.

- Key performance indicators should be established, monitored and reported to measure the quality of improvement work.

- Service providers must maintain a 'close' relationship with the buyer organisation to enable joint problem solving in cross functional (and cross company) teams.

- Company policies must drive continuous improvement work.

- Management commitment in providing clear targets for continuous improvement work is essential for success.

- Continuous improvement work must be targeted towards higher goals such as those of The Natural Step framework.

6.1 Further Research

According to the focus group, the model for engagement proposed in this research could be used successfully for a variety of situations where a service provision contract is in place. However, implementation of the model must be studied in order to determine its true value.

While this case highlighted the need to ensure that service providers were capable of contributing to continuous improvement work, it remains to be seen exactly what actions should be taken to achieve this goal. Research should be conducted into the ways in which the relationship between the buyer and supplier could be streamlined such that the flow of information between organisations, and the access to resources and expertise, is ensured.

To effectively measure the success of continuous improvement work, key performance indicators must be developed. While a service contract typically involves a number of key performance indicators that measure aspects of the services being provided, a set of key performance indicators should also be used specifically to measure the success of continuous improvement work.

Although company policies can easily contain commitments to conducting continuous improvement it remains to be seen exactly how company policies can be enforced within a company as large and complex as the Volvo Group. It was revealed that company policies and goals are interpreted at many levels of the organisation but it is still not clear how policies can be used to force actions at an operational level.

On a similar note, how to encourage commitment from management also requires further investigation. Research should be conducted to gain a better understanding of the factors affecting management's level of commitment in an attempt to better understand how it can be improved.

Finally, research should be conducted into how the goals of sustainable development, such as those set out by the Natural Step Framework, could be integrated into the policies and systems of the Volvo Group.

6.2 Concluding Remarks

This study aimed to build an understanding of how a large business engages its service providers in continuous improvement. Through a case study of Volvo Construction Equipment's Component Division at Eskilstuna, it was revealed that many system and actor elements existed that could contribute positively to a successful engagement between VCE CMP and BP Castrol. A solution was proposed to VTEC concerning the best way for VCE CMP to engage with BP Castrol in order to work towards continuous improvement. It was accepted that the model could be used in the Eskilstuna case and that it could be applied in other cases where Volvo Group companies should work with service providers towards continuous improvement.

Bibliography

About The Natural Step. (2003). Retrieved 9th July, 2007, from http://www.naturalstep.org/com/TNS%5Ffor%5Fbusiness/About%5FTNSI/

Anderson, R. C. (1998). *Mid-Course Correction*. Atlanta: Peregrinzilla Press.

Antony, J. (2004). Some pros and cons of six sigma: an acadmic perspective. *The TQM Magazine, 16*(4), 303-306.

Antony, J. (2006). Six sigma for service processes. *Business Process Management Journal, 12*(2).

Australia/New Zealand Standard: Environmental management systems - Requirements with guidance for use. (2004). (AS/NZS ISO 14001:2004 ed.).

Australia/New Zealand Standard: Quality Management Systems - Requirements. (2000). (AS/NZS ISO 9001:2004 ed.).

Berger, A. (1997). Continuous improvement and kaizen: standardization and organisational designs. *Integrated Manufacturing Systems, 8*(2), 110-117.

Bhuiyan, N., & Baghel, A. (2005). An overview of conitnuous improvement: from the past to the present. *Management Decision, 43*(5), 761-771.

Brar, G. S. (2006). Keeping the wheels turning. *IEE Manufacturing Engineer, February/March*, 32-35.

Brundtland, G. H. (1987). *Our Common Future*. Oxford: Oxford University Press.

Bryman, A. (2004). *Social Research Methods* (2nd ed.). Oxford: Oxford University Press.

Charter, M., & Tischner, U. (2001). *Sustainable Solutions: Developing Products and Services for the Future*. Sheffield: Greenleaf Publishing.

Das, A., Narasimhan, R., & Talluri, S. (2006). Supplier integration - Finding an optimal configuration. *Journal of Operations Management, 24*, 563-582.

DeSimone, L. D., & Popoff, F. (1997). *Eco-Efficiency: The Business Link to Sustainable Development*. Cambridge: MIT Press.

Easterby-Smith, M., Thorpe, R., & Lowe, A. (1991). *Management Research: an Introduction*. London: SAGE Publications Ltd.

Flick, U. (2006). *An introduction to qualitative research* (Third ed.). London: SAGE Publications.

Frankel, C. (1998). *In Earths Company: Business, Environment and the Challenge of Sustainability*. Gabriola Island: New Society Publishers.

Goffin, K., & Lemke, F. S., M. (2006). An exploratory study of 'close' supplier-manufacturer relationships. *Journal of Operations Management, 24*, 189-209.

Grant, R. M. (1996). Prospering in dynamically-competitive environments: Organisational capability as knowledge integration. *Orgaization Science, 7*(4), 375-387.

Gummesson, E. (2000). *Qualitative methods in management research* (Second ed.). Thousand Oaks: Sage Publications, Inc.

Henderson, R. M., & Clark, K. B. (1990). Architectural Innovation: The reconfiguration of Existing Product Technologies and the Failures of Established Firms. *Administrative Science Quarterly, 35*(1), 9-30.

Interface Annual Report. (2006). Retrieved 6th June, 2007, from http://library.corporate-ir.net/library/11/112/112931/items/242193/Interface_AR06_10K.pdf

Interface Sustainability: Global Metrics. Retrieved 6th July, 2007, from http://www.interfacesustainability.com/metrics.html

Jones, N., & Klassen, R. D. (2001). Management of pollution prevention: Integrating environmental technologies in manufacturing. In J. Sarkis (Ed.), *Greener Manufacturing and Operations: From design to delivery and back*. Sheffield: Greenleaf Publishing Limited.

Jørgensen, T. H., Remmen, A., & Mellado, M. D. (2006). Integrated management systems - three different levels of integration. *Journal of Cleaner Production, 14*, 713-722.

Krause, D. R. (1999). The antecedents of buying firms' efforts to improve suppliers. *Journal of operations Management, 17*, 205-224.

Krause, D. R., Handfield, R. B., & Tyler, B. B. (2007). The relationships between supplier development, commitment, social capital accumulation and performance improvement. *Journal of Operations Management, 25*, 528-545.

Krause, D. R., Scannell, T. V., & Calantone, R. J. (2000). A structural analysis of the effectiveness of buyers firms' strategies to improve supplier performance. *Decision Sciences, 31*(1), 33-55.

Kurdve, M. (2006). *Chemical Mangement Services: Safegaurding environmental outcomes*. Paper presented at the EMAN Conference.

Lycke, L. (2003). Team development when implementing TPM. *Total Quality Management, 14*(2), 205-213.

Manos, A. (2007). The benefits of kaizen and kaizen events. *Quality Progress, 40*(2), 47-48.

Manzini, E., & Vezzoli, C. *Product-Service Systems and Sustainability: Opportunities for ustainable solutions*. Paris: United Nations Environment Programme.

Modi, S., & Mabert, V. (2007). Supplier development: Improving supplier performance through knowledge transfer. *Journal of Operations Management, 25*, 42-64.

Mont, O. K. (2002). Clarifying the concept of product–service system. *Journal of Cleaner Production, 10*, 237-245.

Morgan, D. L. (1998). *The Focus Group Guidebook*. Thousand Oaks: SAGE Publications.

NAP. (2007). Volvo Group NAP Environmental Assessment. Retrieved 27th June, 2007, from http://www.volvo.com/NR/rdonlyres/EED541C5-52F4-43C9-BEAF-5E63004147B5/0/NAPEnvironmentalSelfAssessment.pdf

Nattrass, B., & Altomare, M. (1999). *The Natural Step for Business: wealth, ecology and the evolutionary corporation*. Gabriola Island: New Society publishers.

Nattrass, B., & Altomare, M. (2002). *Dancing with the Tiger: Learning Sustianability Step by Natural Step*. Gabriola Island: New Society Publishers.

The Natural Step International Gateway. (2003). Retrieved 9th July, 2007, from http://www.naturalstep.org/com/Start/

O'Leary, Z. (2005). *Researching real-world problems: a guide to methods of inquiry*. London: SAGE Publications.

Quinn, F. (2005). The lion of lean: an interview with James Womack. *Supply Chain Management Review, 9*(5), 28-33.

Reinhardt, F. L. (2000). *Down to earth: applying business prinsciples to environmental management* Boston: Harvard Business School Press.

Robert, K.-H., Schmidt-Bleek, B., Aloisi de Larderel, J., Basile, G., Jansen, J. L., Kuehr, R., et al. (2002). Strategic sustainable development - selection, design and synergies of applied tools *Journal of Cleaner Production, 10*, 197-214.

Sarkis, J. (2001). *Greener manufacturing and operations: from design to delivery and back*. Sheffield: Greenleaf Publishing Limited.

Simon, K. DMAIC Versus DMADV. Retrieved 17th July, 2007, from http://www.isixsigma.com/library/content/c001211a.asp

Stake, R. E. (1995). *The Art of Case Study Research*. London: SAGE Publications.

Stead, W. E., Stead, J. G., & Starik, M. (2004). *Sustainable Strategic Management*. New York: M. E. Sharpe.

Stoughton, M., & Votta, T. (2003). Implementing service-based chemical procurement: lessons and results. *Journal of Cleaner Production, 11*, 839-849.

Thun, J.-H. (2006). Maintaining preventive maintenance and maintenace prevention: analysing the dynamic implications of Total Productive Maintenance. *System Dynamics Review, 22*(2), 163-179.

Tice, J., Ahouse, L., & Larson, T. (2005). Lean Production and EMSs: Aligning environmental management and business priorities. *Environmental Quality Management, 15*(2), 1-12.

USEPA. (2003). *Lean Manufacturing and the Environment*.

Vachon, S., & Klassen, R. D. (2007). Supply chain management and environmental technologies: the role of integration. *International Journal of Production Research, 45*(2), 401-423.

Vandenbosch, B. (2003). *Designing solutions for your business problems: a structured process for managers and consultants*. San Fransico: Jossey-Bass.

Volvo. KTC Production. Retrieved 25th June, 2007, from http://violin.volvo.net/volvotechnology/corporate/en/communities/gib_technology/organisation/key_technology_committees/KTC_production/ktc_production.htm

Volvo. Operational Development in the Volvo Group. Retrieved 26th June, 2007, from http://violin.volvo.net/volvogroup/corporate/en/communities/communities_od/about_od/about_od.htm

Volvo. Volvo Technology Key Facts. Retrieved 25th June, 2007, from http://violin.volvo.net/volvotechnology/corporate/en/business_functions/about_VTEC/key_facts/key_facts.htm

Volvo. (2003). Environmental requirements for production sites and other operating units within the Volvo Group. Retrieved 25th June, 2007, from http://violin.volvo.net/volvonet/vebiz2webauthor/dialogs/GoogleCachePage/GoogleCachedResult.aspx?CID=zBmUjUFUueYJ&cacheUrl=http://violin.volvo.net/volvogroup/corporate/en/policies_and_strategies/policies_directives_guidelines/general/directives/docfetch.htm%3FDocID%3D29%26ListID%3D%257Be714b8b5-0671-4ffe-8fef-7ff910c1f49c%257D%26Area%3DVolvo%2520Group%2520Policies%26UseSecure%3Dfalse%26application%3Dviolin

Volvo. (2004a). Environmental Policy. Retrieved 8th June, 2007, from http://www.volvo.com/vce/vebiz2webauthor/sharepoint/docfetch.aspx?docID=62&listID=a560d670-9b7a-40ff-845b-f34973fc7493&area=VolvoCom+Volvo+Group

Volvo. (2004b). Quality Policy. Retrieved 8th June, 2007, from http://www.volvo.com/vce/vebiz2webauthor/sharepoint/docfetch.aspx?docID=52&listID=a560d670-9b7a-40ff-845b-f34973fc7493&area=VolvoCom+Volvo+Group

Volvo. (2004c). The Volvo Way. Retrieved 27th June, 2007, from http://violin.volvo.net/volvogroup/corporate/en/policies_and_strategies/our_values/the_volvo_way/policies_strategies_our_value_volvo_way.htm

Volvo. (2006a). Volvo Corporate GDP. Retrieved 28th June, 2007, from http://violin.volvo.net/volvogroup/corporate/en/global_projects/corporate_gdp/corporate_gdp.htm

Volvo. (2006b). The Volvo Group 2006. Retrieved 19th June, 2007, from http://www.volvo.com/NR/rdonlyres/90719C03-4AC1-4DFA-BB93-2E6150E8670A/0/070319_volvo_engelsk_150dpi.pdf

Volvo. (2006c). Volvo Group NAP: Non-Automotive Purchasing. Retrieved 26th June, 2007, from http://www.volvo.com/NR/rdonlyres/AD51F571-4DE7-478E-B2D2-7460A008D419/0/NAPBrochure2006.pdf

Volvo. (2006d). Volvo Technology Organisation. Retrieved 11th June, 2007, from http://violin.volvo.net/volvotechnology/corporate/en/business_functions/about_VTEC/company_structure/company_structure.htm

Volo. (2007a). Organization Chart. Retrieved 25th July, 2007, from http://www.volvo.com/group/global/en-gb/Volvo+Group/our+companies/

Volvo. (2007b). VCE Strategic Objectives 2007-2009. Retrieved 26th June, 2007, from http://violin.volvo.net/volvoce/corporate/en/policies_and_strategies/strategies/strategic_objectives/strategic_objectives.htm

Volvo. (2007c). Volvo Group Strategic Objectives.

Volvo. (2007d). Volvo Production System: VPS Overview. Retrieved 26th June, 2007, from http://violin.volvo.net/vtec/gibt/vps

Volvo. (2007e). VPS - Training module overview. Retrieved 27th June, 2007, from http://violin.volvo.net/vtec/gibt/vps

Volvo. (2007f). VPS Model Version 3 - Updated. Retrieved 26th June, 2007, from http://violin.volvo.net/vtec/gibt/vps

Willard, B. (2002). *The Sustainability Advantage: Seven business case benefits of a triple bottom line.* Gabriola Island: New Society Publishers.

Womack, J. P., Jones, D. T., & Roos, D. (1991). *The Machine That Changed the World*. New York: HarperPerrenial.

Interviewees

Axelsson, Niklas. (2007, July 5) Phone interview.

Brun, Ragnhild. (2007, June 28) Personal interview.

Higgins, Adrian. (2007, July 16) Phone interview.

Hill, Bert. (2007, June 11) Personal interview.

Johansson, Mikael. (2007, June 12) Personal interview.

Kurdve, Martin. (2007) Personal communication.

Mattila, Pauli. (2007, June 12) Personal interview with Martin Kurdve as translator.

Niklasson, Helene. (2007, June 11) Personal interview.

Rydström, Anne-Marie. (2007, June 28) Personal interview.

Schiöler, Josef. (2007, June 28) Personal interview.

Stjernstoft, Tero. (2007, June 12) Personal interview.

Svenningstorp, Johan. (2007, July 26) Phone interview with Martin Kurdve.

Svensson, Robert. (2007, June 11) Personal interview.

Westerberg, Sofia. (2007, June 12) Personal interview.

Abbreviations

BA	Business Area
BMS	Business Management System
BU	Business Unit
CMS	Chemical Management Service
CS09	Component System 2009
DMADV	Define-Measure-Analyse-Design-Verify
DMAIC	Define-Measure-Analyse-Improve-Control
EMS	Environmental Management System
GDP	Global Development Process
GIB	Group Issue Board
ISO	International Standardisation Organisation
KPI	Key Performance Indicator
KTC	Key Technology Committee
NAP	Non-Automotive Purchasing
OD	Operational Development
OEE	Overall Equipment Effectiveness
PDCA	Plan-Do-Check-Act
PSS	Product-Service System
QMS	Quality Management System
TCO	Total Cost of Ownership
TNS	The Natural Step
TPM	Total Productive Maintenance
VCE	Volvo Construction Equipment
VCE CMP	Volvo Construction Equipment Component Division
VPS	Volvo Production System
VTEC	Volvo Technology

Appendix I – Workshop Session Summary

Session and Attendees

The workshop session was successfully run on the 14th of August 2007 at VTEC in Göteborg from 1100 until 1530. The following individuals were in attendance for whole or part of the workshop session:

For the morning session 1100-1200

- Douglas Helman, Masters student, EMP, IIIEE, Lund, Sweden
- Martin Kurdve, Project manager for process media infrastructure development at Eskilstuna plant, VTEC, Göteborg.
- Helene Niklasson, Manager of Environment and Chemistry, VTEC, Göteborg.
- Bert Hill, Volvo Production System, Project Area Manager, VTEC, Göteborg.
- Josef Schiöler, Global Methods and Standards Manager Volvo 3P, Volvo Trucks, Göteborg.

Afternoon session 1300-1530:

- All the above plus;
- Henrik Kloo, Project Area Manager for Sustainability and Environmental Technology, VTEC, Göteborg.
- Sofia Westerberg, Environmental Coordinator, VCE AB, Component Division, Eskilstuna. – via phone
- Peter Johansson, NAP Eskilstuna local purchasing – via phone.

The morning session (1100-1200) session was introduced by Martin Kurdve who outlined the origins of the investigation and then introduced some of the key issues. Douglas Helman then further discussed some of the key findings as outlined in the Workshop Session Briefing Notes distributed to session attendees.

The session broke for lunch at approximately 1200.

The afternoon session was attended by Sofia Westerberg and Peter Johansson by phone. Some important issues were outlined again briefly for their benefit and then Douglas Helman continued discussing the issues outlined in the briefing notes. After some time, Douglas began discussing the way in which his proposed solution was developed and then the solution was presented. Discussion around the Discussion Questions followed with valuable input from all attendees.

The session was concluded at approximately 1530. Participants were thanked for their time and input.

Results

Changes to the Model

Firstly, it was established that two key organisational elements were missing from the existing model and, therefore, from the proposed solution. The elements added were:

- Production – at an operational level, like the maintenance department, this group is responsible for conducting production operations at Eskilstuna,

- CMS Board – this group is outlined above and fits within Eskilstuna.

The updated model is shown below and includes the following updates:

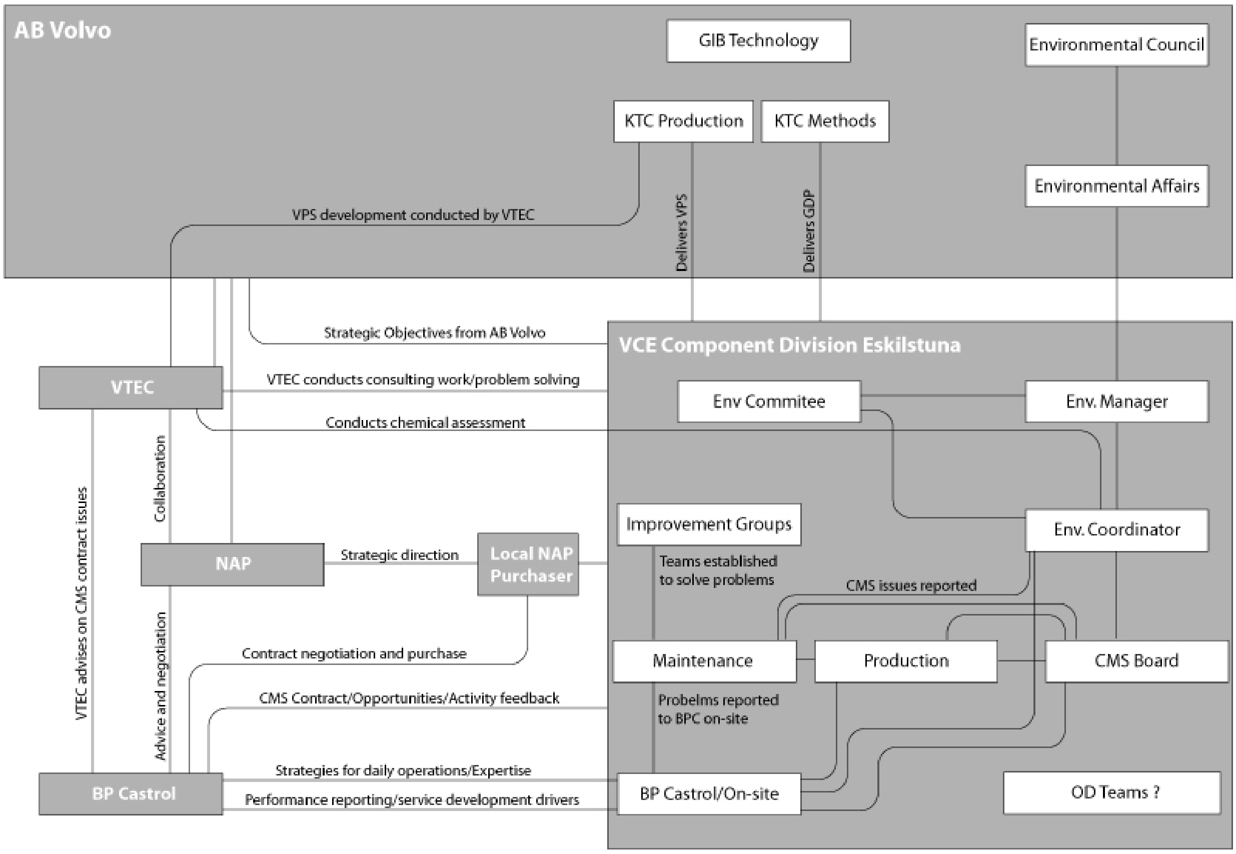
- The CMS Board and Production units have been added,

- Links between the CMS Board and Production, Maintenance, the Environmental Coordinator and BP Castrol on-site have been added.

- A direct link between the Environmental Coordinator and BP Castrol on-site has been added,

- A link between BP Castrol on-site and Production has been added,

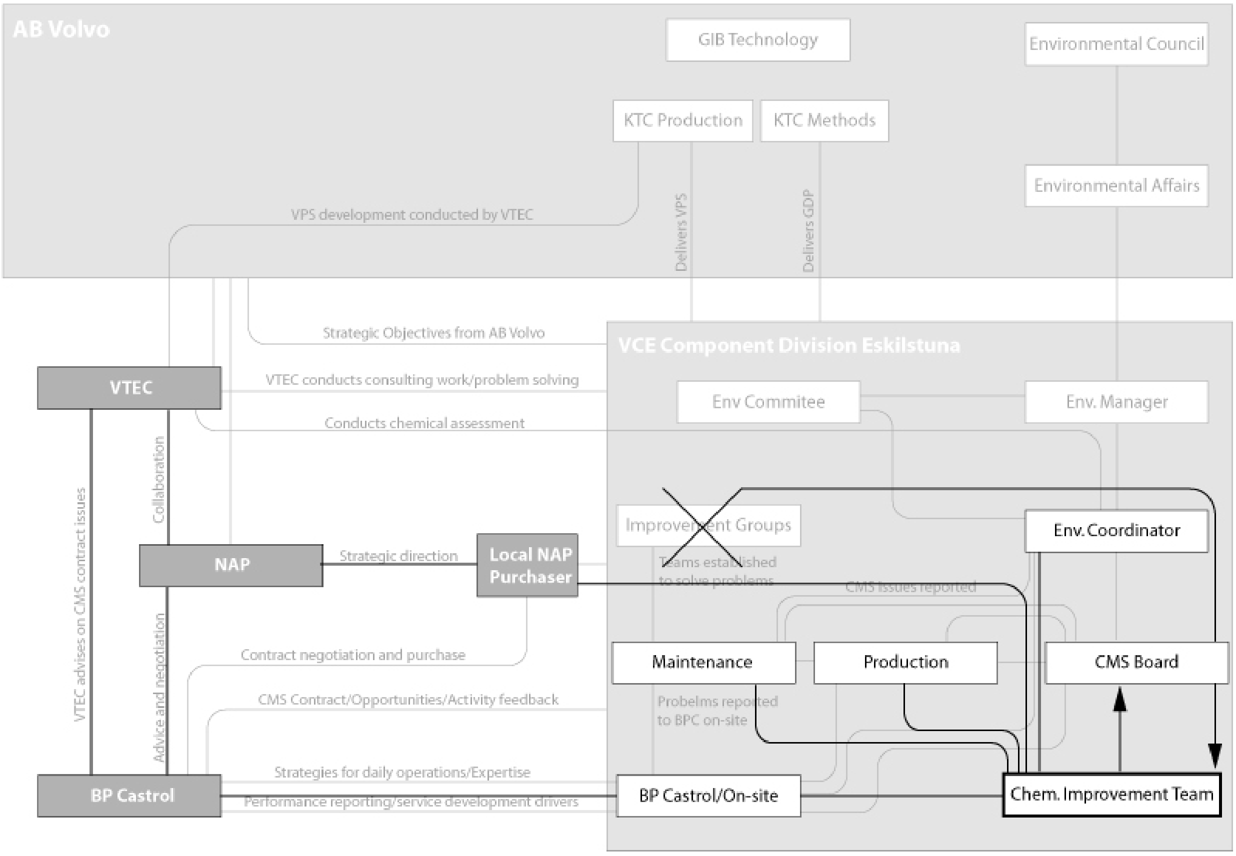
- Links between Production and Maintenance and the Maintenance and the CMS Board have been added.



Updated Solution

In line with the discussion, and in light of the additions described above, the proposed solution is modified in the following ways:

- A link is added between BP Castrol off-site and BP Castrol on-site. This link is to allow BP Castrol to communicate amongst themselves regarding opportunities for continuous improvement.
- A link is added between the Chemical Improvement Team and the CMS Board. The intention is that the CMS Board remain as the advisory body but that the operational level work be conducted by the Chemical Improvement team.
- The direct link between VTEC and the Chemical Improvement team is removed in light of the concern that VTEC would not be able to engage its staff in such a team.
- In the same way, the direct link between NAP and the Chemical Improvement Team is also removed.



The proposed solution is revised as:

1. The experience of Eskilstunas previous improvement groups should be harnessed by forming a team called the Chemical Improvement Team (CI Team). This group could be consolidated from a number of existing groups or could be a newly formed team.
2. This team would be designed according to the requirements of the Design for Improvement Organisation module within the VPS and would include at minimum:

a. **Environmental coordinator:** acting as a link between the environmental committee, maintenance, production and BP Castrol on-site. Environmental focus would be provided by this representative.

b. **Quality representative:** provided by the production department. This representative is responsible for guiding the quality aspects of chemical improvement work and providing expertise in the technical aspects of the chemical handling/management systems infrastructure and conducting the physical work for system improvements

c. **Maintenance representative:** providing expertise in the technical aspects of the chemical handling/management systems infrastructure and conducting the physical work for system improvements.

d. **BP Castrol on-site:** providing expertise on the use of chemicals and ways that chemical use can be further improved.

e. **Local NAP representation:** acting as a relationship manager between BP Castrol and Volvo and ensuring any necessary contractual changes are made.

f. **Additional expertise:** as required (Can include global NAP and VTEC representatives or consultants).

3. This team would act on a local operational level, conducting daily work towards continuous improvement such as identifying opportunities, establishing goals, implementing actions and reporting results.

4. The CI Team would report regularly to the CMS Board.

5. The CMS Board would report regularly to the VCE Component Division production management.

6. VTEC should maintain its position as advisor and consultant to BP Castrol and VCE. If possible they should also provide guidance to the CI Team. Alternatively, they could provide guidance to a centrally located CI Team potentially situated in NAP.

7. NAP should retain its position as a contract negotiator and should maintain its roles as advisor to BP Castrol and VCE.

8. BP Castrol off-site should work more closely with VTEC and NAP to establish strategic level continuous improvements.

Continuous Improvement

Discussion clearly revealed some confusion about the definition of continuous improvement. The formal definitions as provided by ISO 14001, ISO 9001 and the VPS system were discussed but it appeared that the participants were not sure whether one definition held true over another or whether there was any conflict between definitions.

Whether there were any NAP strategies for continuous improvement was discussed and no specific strategies were identified. It was noted, however, that continuous improvement is a site specific activity.

One participant pointed out that the definition provided by ISO 14001 is the one that should be used and, evidently, its most important characteristic is that the improvement work is ongoing.

A representative of the VPS suggested that the definition of continuous improvement within that framework is: A documented process of identifying and implementing improvements, based on standardisation and employee involvement, and completed according to the PDCA cycle.

Conclusion: *the definition of continuous improvement is not clear. A definition that is applicable across all ISO certifications, the VPS and existing improvement methodologies should be established.*

Global Development Process (GDP)

The role of the GDP in conducting continuous improvement work was discussed. It was agreed that the GDP process is intended for larger 'big-bang' projects, such as plant expansion or product development, rather than small daily improvement activities. It was also agreed that the process could be used for larger continuous improvement projects. A conclusion was reached that the GDP was not applicable to the case at Eskilstuna.

One participant pointed out that continuous improvement has been successfully used in conjunction with the GDP in Volvo Trucks in Curitiba, Brazil, highlighting the fact that the systems can be used in this way.

Conclusion: *Continuous improvement work focuses on small daily improvements whereas the GDP focuses on completing large projects successfully. For this reason no link exists between the situation at Eskilstuna and the GDP, nor should one be created.*

Operational Development (OD)

The use of OD teams within the VPS framework to conduct continuous improvement work was discussed. Eskilstuna representatives noted that OD was a completely new concept to them and that they were not using that system yet. However, they pointed out that improvement groups already existed. These groups exist within the production area but no such group exists in relation to chemicals.

Conclusion: *The value of teamwork is well established even though it is not necessarily called operational development.*

Substitutionprojekt

The Substitutionprojekt database within the MOTIV database was discussed. Interestingly, some VTEC staff were unaware that such a system existed. Eskilstuna representatives noted that they were not using the database. It was also pointed out that BP Castrol do not currently have access to that system but that that could be arranged. In addition a general comment was made that that page, currently only in Swedish, should be provided in English.

Conclusion: *The Substitutionprojekt page should be used to gather information regarding the experiences of BP Castrol in conducting substitution of chemical products.*

Conclusion: *Actions should be taken to allow BP Castrol to help Eskilstuna with substitution projects.*

Continuous Improvement within the CMS

For clarification, Eskilstuna representatives described the way in which ideas for continuous improvements are raised. In the event that BP Castrol has an idea for such work, they are able to take the idea to the CMS Board meeting or are able to report the idea to the environmental coordinator who then raises it at the CMS Board meeting. It was noted that ideas can also be reported to the CMS Board in the same way from Volvo personnel.

BP Castrols past continuous improvement work was shortly discussed. One interesting comment was that, while BP Castrol claim to implement 1-2 continuous improvement projects a year, Eskilstuna representatives felt that the definition of continuous improvement project was different depending whether you were BP Castrol or Volvo. This indicated some dissatisfaction with BP Castrols efforts towards continuous improvement. Eskilstuna representatives confirmed this dissatisfaction noting that in the past BP Castrol did not perform well in the area of continuous improvement but that that had changed recently.

The possibility of placing more emphasis on continuous improvement within the CMS contract was discussed and an NAP representative noted that there was no need to take such measures. VTEC representatives agreed that the contract was strong enough in that area.

However, one VTEC representative noted that the quality of the improvement projects could be improved. The idea that Eskilstuna did not have enough access to a wide experienced workforce within BP Castrol, noting that all their contact is through one BP Castrol representative. This highlighted the notion that perhaps BP Castrol could contribute a wider knowledge base to Volvo but were not currently. It was also noted that BP Castrol needs to work more closely with production process development.

The discussion turned to documentation of continuous improvement work and the first comment of note was that there is currently no requirement for parties to document any aspect of continuous improvement work whether that is goal setting, actions taken or evaluations. It was then clarified that those comments related to waste contractors who were doing some improvement work. Within the CMS it was pointed out that there is a form for documenting improvement work conducted by NAP, BP Castrol or Eskilstuna.

Conclusion: *Reporting ideas for continuous improvement to the CMS Board works well. This link should be maintained.*

Conclusion: *Continuous improvement is not clearly defined.*

Conclusion: *The quality of improvement work could be improved, perhaps through BP Castrol providing Volvo with access to a wider knowledge and experience base, rather than only one BP Castrol representative.*

Conclusion: *Conditions should exist that allow BP Castrol to work more closely with Production on-site.*

Conclusion: *In general, service suppliers could learn from the CMS contract regarding how to document continuous improvement work.*

The CMS Board

For clarification, the CMS Board consists of the following representatives:

- Maintenance manager,
- Purchasing (NAP), Peter Johansson
- Environmental, Sofia Westerberg,
- Production, Pauli Mattila,
- Production.

With respect to this board it was noted that it is necessary to encourage this board to meet with VCE top management at least yearly.

The role of the CMS Board was discussed as potentially fulfilling all the roles of the proposed CI Team. It was agreed that there was a difference in the operating levels of these groups. At the operational level the CI Team would perform daily actions, whereas, the CMS Board would operate on a management level. It was noted that for other service contracts, such as waste or facility management, there are no functioning boards. In these cases a manager is responsible for decision making without the support of a team.

Conclusion: *The CMS Board should remain in the model and should act as a link between the CI Team and VCE top management.*

Conclusion: *The general model should include a team for decision support/decision making.*

The role of Management

An aspect that was not discovered during data gathering, but was raised during this session was that of the role of management. Eskilstuna representatives felt that management should take more responsibility for delivering goals for continuous improvement down the hierarchy. A VTEC representative confirmed this feeling noting that there must be a clear emphasis on management providing guidance and that there must be a very clear commitment to continuous improvement at a management level. The focus of lean production is to involve all workers in improvement work and in that respect; goals for work are developed at lower levels of the organisation and delivered up to management. One VTEC representative noted that, in this case, goals should be clearly converted into terms understood by management.

A discussion followed about the problems associated with changing environmental goals for economic terminology for the benefit of management. One VTEC representative strongly defended the position that environmental goals should be presented on their own merits rather than from an economic perspective. Consensus on that issue was not reached and the discussion was guided away from this topic.

It was noted that management should be involved in goal setting to ensure that they are committed to the goals of continuous improvement. One VTEC representative suggested that someone needs to show enthusiasm for continuous improvement, especially environmentally oriented actions.

The case at Eskilstuna demonstrates that responsibility for the CMS contract has been delegated down to the CMS Board. It was suggested that actions should be taken to encourage VCE top management, those who delegated this area of work, to be more involved once again. One way of doing that is to ensure that the CMS Board reports to top management at least yearly.

Conclusion: *Management must commit to goals developed by lower level teams in accordance with the VPS and other relevant systems.*

Conclusion: *Management must provide clear direction for continuous improvement by contributing to goal setting for continuous improvement.*

CI Team Permanence

The proposed solution involves establishing a permanent CI Team on-site. Discussion suggested that there may not be enough work to warrant a permanent team. However, it was acknowledged that this issue is site-specific and that the question should be asked of each site.

Conclusion: *A CI Team could act in a permanent way by interacting regularly but not necessarily every day.*

Appropriateness of VPS

One VPS representative agreed that continuous improvement work should be conducted under the umbrella of the VPS. However, another VTEC representative suggested that there may be a problem with the definition of continuous improvement work under that system. The concern raised was that work conducted within the VPS focused more on quality and less on environment. An interesting discussion about the place of 'environment' within the VPS followed and it was clear that perhaps the 'environment' did not hold as strong a position as quality within the VPS umbrella. In essence, the concern was that there was not as much emphasis placed on improvement work conducted for the benefit of environment as for quality.

Despite some concern on this issue, it was determined that any continuous improvement work done under the VPS umbrella should also be conducted in accordance with the requirements of Eskilstunas ISO 14001 environmental management system. It was acknowledged that these systems were not in conflict and that perhaps continuous improvement work could be conducted under the guidance of the environmental management system under the umbrella of the VPS.

Conclusion: *Continuous improvement work should be conducted by a team in accordance with the ISO 14001 certification under the umbrella of the VPS.*

Conclusion: *Equal emphasis must be placed on continuous improvement work conducted for the benefit of the economy, society and environment.*

Ownership of the CMS Contract

Some discussion centred on who should own the CMS Contract. Currently it is owned by the production manager at Eskilstuna but has been delegated down to the maintenance department. One Eskilstuna representative suggested that perhaps this arrangement is not optimal and that the CMS contract would be better owned by production. Specifically, the production manager should be the individual ultimately responsible for the CMS contract because they would be more involved in future. It was noted that this was in line with lean production literature.

Conclusion: *The CMS contract should be owned and controlled by the Production Manager.*

Communication

The issue was raised that the goals of the environmental policy were perhaps not being communicated effectively. Specifically, the aspect that all personnel should be involved in continuous improvement is not communicated clearly enough. It should be mentioned that the VPS has a very clear focus on involving all.

Conclusion: *Continuous improvement work should occur as an action in response to the environmental and quality policies.*

Integrated Management Systems

An integrated environmental and quality management system will soon be implemented in Eskilstuna called the Business Management System (BMS). In the updated model, the CI Team includes representatives from the environmental and quality departments. However, with the introduction of the BMS, this could be reduced to one representative covering both environmental and quality issues.

Conclusion: *The CI Team should contain representatives from the environmental (ISO 14001) and quality (ISO 9001) departments or, where it exists, a representative from the BMS department.*

The General Model

The above discussion results drifted between discussing the specific model for Eskilstuna and the how the model should be different for a general case. However, it was agreed that the following elements should exist in a general model:

- Environmental representation,
- Quality representation,
    - Alternatively, BMS representation,
- Technical expertise (Volvo),
- Technical expertise (Service provider),
- Local purchasing representative,
- Additional expertise as required.

The placement of such a team was discussed and it was concluded that such an improvement team could be situated locally in accordance with local requirements. The possibility of having a centrally located service issues team was discussed. Such a team could be situated within the NAP group and might be responsible for handling all service provision related continuous improvement for one service or one supplier. The main role of such a team might be to ensure commonality across all similar service provision contracts.

The concern was raised that it would not be possible to place VTEC and/or NAP global representatives in all local level teams.

It could be argued that continuous improvement work should be conducted by teams working within the requirements of the soon to be implemented BMS (which would essentially be the ISO 14001 and 9001 systems combined) and should be in accordance with the principles of the VPS.

The applicability of the model to other cases was discussed and it was agreed that there was potential to implement such a team approach to continuous improvement in the area of waste management. It was also noted that there was potential to implement service contracts in the paint shop and in that case such an arrangement for continuous improvement could also be used.

Conclusion: *The model for continuous improvement can be applied to other service provision contracts especially in the waste management area and the paint shop.*

Appendix II – AB Volvo Environmental Policy

Environmental Care is a Volvo Core Value. The Volvo Group is to be ranked as a leader in terms of Environmental Care among the world's top producers of transport related products, equipment and systems. The environmental programmes shall be characterised by holistic view, continual improvement, technical development and resource efficiency. The Volvo Group will by these means gain competitive advantage and contribute to sustainable development.

Holistic view

In our efforts to reduce environmental impact from our products, operations and services we shall:

- take account of the complete life cycle;
- take a leading position regarding environmental care, wherever in the world we operate, with applicable legislation and other regulations as a minimum standard;
- make pollution prevention a prerequisite for all operations;
- encourage suppliers, dealers and other business partners within our sphere of influence to adopt the principles in this policy.

Continual Improvement

Our environmental activities shall be integrated in all operations and be improved continually by:

- formulating, communicating and monitoring clearly-defined goals;
- involving our employees.

Technical development

We shall strive to exceed demands and expectations from our customers and society by:

- active and future-oriented research and development efforts;
- developing transport solutions with low environmental impact;
- promoting development of harmonized legal requirements;
- continually reducing our products' fuel consumption, exhaust emissions, noise and impact on climate change;
- reducing the use of environmentally harmful materials.

Resource efficiency

Taking account of the complete life cycle, our products and industrial operations shall be such that:

- the consumption of energy and raw materials is minimised;

- the production of waste and residual products is minimised, and waste management is facilitated.

The environmental programmes and their results shall be communicated in an open and factual manner. Business areas and business units are responsible for implementing action programmes based on this Policy.

March 24th, 2004

Leif Johansson

President of AB Volvo and CEO

Supersedes policy dated September 16th, 1997 960-04-030

RSP 011-2010/01

Appendix III – AB Volvo Quality Policy

As Quality is a corporate value of the Volvo Group, the Group shall be ranked as a leader in terms of Quality among the world's providers of transport-related hard and soft products. This will be achieved by all Business Areas and Units through customer focus built on leadership commitment, participation by everyone, and a process culture.

Customer Focus
Quality is a measure of our performance as experienced by our customers. Success in the market depends on our ability to:

- understand and satisfy customer needs;
- exceed customer expectations.

To succeed we must do this better than our competitors, which requires that we listen to our customers, and plan continuous and sustainable improvements in our operations based on their input.

Leadership Commitment
All leaders shall show a clear commitment to Quality by:

- communicating clear objectives, moving from word to action; we have to be able to: Quantify-Measure-Deliver;
- developing the competence of all employees, giving them the means to reach their objectives, and delegating as much authority and responsibility as possible;
- basing their actions on facts, a holistic view of operations, and a long-term perspective.

Participation by Everyone
Every employee within the Volvo Group and also employees with Suppliers, Distributors and Dealers, shall:

- be given the means to understand his/her role, and be empowered to take responsibility for the quality of his/her own work;
- have a well-informed and consistent view of the objectives to be achieved and the desired results;
- be expected to actively contribute, in cooperation with others, to fulfilling Group objectives.

Process Culture
We shall identify, document and continuously improve our processes by:

- working toward achieving maximum customer value, and zero defects;

- establishing, working toward, and monitoring our results against measurable process objectives;
- comparing ourselves with others, and learning from the best.

Authorised as of 21/04/2004.

Leif Johansson

President and CEO of the Volvo Group