CHALMERS

Supplier performance dashboard

At Volvo Logistics

Master of Science Thesis in the Master Degree Programme Supply Chain Management

JEANETTE GUSTAFSSON

ERIKA KARLSSON

Department of Technology Management and Economics
Division of Logistics and Transportation
CHALMERS UNIVERSITY OF TECHNOLOGY
Göteborg, Sweden, 2012
Report No. E2012:025

Supplier Performance Dashboard
At Volvo Logistics

JEANETTE GUSTAFSSON & ERIKA KARLSSON

Report No. E2012:025
Department of Technology Management and Economics
CHALMERS UNIVERSITY OF TECHNOLOGY
SE – 412 96 Göteborg
Sweden
Telephone +46 (0)31-772 1000

Cover:
Volvo Logistics provides the Volvo Group and external customers with complex transportation solutions, and a Supplier performance dashboard would help the company in its supplier evaluation process.

Reproservice, Chalmers
Gothenburg, Sweden, 2012

Abstract

In order to be successful in the competitive business environment of today, companies cannot operate in isolation and only rely on its own performance. They are highly dependent on the performance of other actors in the supply chain as well, not least the suppliers. This increases the need for supplier performance assessment; to evaluate and ensure that the suppliers perform according to the level of performance that is required by the buying firm.

This thesis was carried out as a case study at the purchasing department of Volvo Logistics (VLC). VLC is the lead logistics provider of the Volvo group; one of the world's leading providers of commercial transport solutions. In order to increase the understanding of the suppliers' performances; the current status and historical development, the purchasing department at VLC desires to compile the most relevant performance metrics into a supplier performance dashboard. A large amount of data exists within different parts of the organization today but for different reasons, it does not reach the purchasing department.

Therefore, this master thesis aims at carrying out pre-study of a supplier performance dashboard; to investigate what KPIs and other measurements that should be included in the dashboard. The dashboard should function as tool for visualization of supplier performance, to support accurate supplier assessments and allow fact based decision making within several areas at the strategic level of the global purchasing function of VLC. In order to fulfill the purpose, the following research questions are answered:

1. *How is the supplier performance evaluation process currently carried out at VLC?*
2. *What performance indicators should be included in the Supplier performance dashboard?*

3a. Where is the information relevant for the Supplier performance dashboard stored?

3b. How can the information relevant for the Supplier performance dashboard be identified?

The empirical results show a decentralized structure of supplier performance measurement within VLC. Seven departments are identified to measure supplier performance and a complex structure with measurements on different levels of detail is revealed; from lane level to contract level, PARMA level, and up to the overall supplier group level. In general, each department has also its own information system to run their operations and to measure supplier performance.

The study concludes that twelve KPIs and measurements are qualified and should be included in the dashboard. These measurements can be categorized into three different groups; operational, financial and core value related measurements. Four measurements were identified as potential to include in the future while four measurements are considered non-applicable for the supplier performance dashboard. The final recommendation to VLC is to implement the twelve measurements in a stage process. System restrictions inhibit instant inclusion of some KPIs and a stage process also allows for testing and modification of some of the elements in the dashboard. It is also recommended to share the information in the dashboard with the suppliers in order to achieve joint efforts of performance improvement.

Keywords: Logistics purchasing, Supplier assessment, Performance indicators, KPI, Supplier performance dashboard.

Acknowledgements

This Master of Science thesis was conducted during the spring of 2012 within the Master Degree Programme of Supply Chain Management at Chalmers University of Technology in Gothenburg, Sweden. The thesis was carried out within the Global purchasing department at Volvo Logistics, Gothenburg.

First we would like to thank Daniela Jidhage and Kjell-Åke Hvittfeldt at Volvo Logistics for initiating this project and giving us the opportunity to conduct the project and write our thesis at the company. We also like to thank Daniela Jidhage for the input, support and encouragement she has provided us with, when acting as our supervisor.

Secondly we also like to thank Arni Halldorsson, our supervisor at Chalmers for his guidance throughout this process. His ideas, knowledge and everlasting enthusiasm over this project has enabled us to overcome any hurdles and allow us to present our best possible report.

Throughout our work with this thesis we have encountered numerous employees within the Volvo Logistics organization, and many of them have taken time apart from their schedule to provide us with needed information in interviews or meetings. Thank you all for your help and for making us feel welcomed during our time at Volvo Logistics. Also thanks to the suppliers of Volvo Logistics and other external interviewees for helping us bring forward our best result possible through your participation in this thesis.

This thesis work has provided us with valuable knowledge for us to bring with us into our professional life after graduation, and we are grateful to Volvo Logistics for providing us with this experience.

Last but not least, a special thank you to our friends and families for your support, especially Joel Bladelius and Fredrik Pettersson. Not only for your support during this thesis work but throughout our entire studies at Chalmers.

Gothenburg, May 2012

Jeanette Gustafsson *Erika Karlsson*

Table of contents

1 INTRODUCTION 1

1.1 BACKGROUND 1
1.2 COMPANY BACKGROUND – THE VOLVO GROUP 2
1.3 COMPANY BACKGROUND – VOLVO LOGISTICS 2
1.4 PURPOSE 3
1.5 PROBLEM ANALYSIS AND RESEARCH QUESTIONS 4
1.6 DELIMITATIONS 5
1.7 REPORT DISPOSITION 5

2 METHOD 6

2.1 QUALITATIVE RESEARCH APPROACH 6
2.2 THE RESEARCH PROCESS 7
2.3 EXPLORATORY, DESCRIPTIVE OR EXPLANATORY APPROACH 7
2.4 RESEARCH STRATEGY 8
2.5 DATA COLLECTION AND DATA ANALYSIS 8
2.5.1 Literature review 10
2.5.2 Interviews 10
2.6 VALIDITY AND RELIABILITY 11
2.6.1 Validity and reliability in the literature review 12
2.6.2 Validity and reliability in the interviews 12

3 THEORETICAL FRAMEWORK 13

3.1 PURCHASING 14
3.1.1 Procurement of Services 16
3.1.2 Supplier base analysis 17
3.2 SUPPLIER ASSESSMENT 18
3.2.1 Motives for supplier assessment 18
3.2.2 Supplier assessment process 19
3.3 PERFORMANCE MEASUREMENTS 20
3.3.1 Key performance indicators 20
3.3.2 Motives for performance measurements 22
3.3.3 Characteristics of performance measurements 22
3.3.3.1 Hard and soft measurements 23
3.3.3.2 Financial and non-financial measurements 23
3.3.3.3 Leading and lagging measurements 24
3.3.4 Framework for evaluating KPIs 24
3.3.5 Transportation KPIs 25
3.4 BUSINESS INTELLIGENCE 26
3.4.1 Dashboards 26
3.4.2 Enterprise dashboards 28
3.4.3 Characteristics of enterprise dashboards 28
3.4.4 Motives for enterprise dashboards 29
3.5 SUMMARY OF THEORETICAL FINDINGS 30

4 EMPIRICAL FINDINGS 32

4.1 THE SUPPLIER PERFORMANCE DASHBOARD AT VLC 34
4.1.1 Areas of application 34
4.1.2 Purchasers view on measurements for the dashboard 35

4.2 THE SUPPLIER BASE 35
4.2.1 Supplier performance requirements *36*
4.2.2 Sourcing strategy *37*
4.2.3 Supplier self-reporting *38*
4.3 SUPPLIER MEASUREMENTS WITHIN VLC 38
4.3.1 Global Purchasing *39*
4.3.1.1 Measurements 39
4.3.1.2 Systems and identification 41
4.4 GLOBAL BUSINESS OPERATIONS 41
4.4.1 Inbound *42*
4.4.1.1 Measurements 42
4.4.1.2 Systems and identification 43
4.4.2 Outbound *44*
4.4.2.1 Measurements 44
4.4.2.2 Systems and identification 45
4.4.3 Emballage and Logistics Services *45*
4.4.3.1 Measurements 46
4.4.3.2 Systems and Identification 46
4.4.4 Emballage transportations *47*
4.4.4.1 Measurements 47
4.4.4.2 Systems and identification 48
4.5 OPERATIONAL EXCELLENCE 48
4.5.1 Measurements *49*
4.5.2 Systems and identification *51*
4.6 RISK MANAGEMENT 52
4.6.1 Measurements *53*
4.6.2 Systems and identification *54*
4.7 INVOICING & COST CONTROL 54
4.7.1 Measurements *55*
4.7.2 Systems and identification *56*
4.8 SUMMARY OF THE EMPIRICAL FINDINGS 58

5 ANALYSIS 60

5.1 DASHBOARD FOR PURCHASING 61
5.1.1 Areas of dashboard application at VLC purchasing *62*
5.2 ASSESSMENT OF POTENTIAL KPIS 64
5.2.1 Ranking of KPIs *79*
5.2.1 Summary of the assessment of potential KPIs *81*
5.3 CHARACTERISTICS OF KPIS 82
5.4 ORGANIZATIONAL REPRESENTATION OF KPIS 86
5.5 EVALUATION OF KPIS AND MEASUREMENTS PER TRAFFIC MODE 89
5.6 SUMMARIZING DISCUSSION OF KPI EVALUATION 91
5.6.1 Critical discussion about the dashboard *95*
5.7 EVALUATION OF SYSTEMS AND TECHNICAL SOLUTIONS 96
5.7.1 Visualization of KPIs *98*
5.8 IMPLEMENTATION PROCESS 100

6 CONCLUSIONS 102

7 RECOMMENDATIONS 106

8 FUTURE RESEARCH 108

REFERENCES 109

APPENDIX 1 – LIST OF INTERVIEWEES 115

APPENDIX 2 – GENERIC INTERVIEW GUIDE 116

APPENDIX 3 – INTERVIEW WITH SUPPLIERS 117

APPENDIX 4 – INTERVIEW GUIDE FOR PURCHASERS 118

APPENDIX 5 – SUMMARY OF MEASURED KPIS 119

APPENDIX 6 – BACKGROUND INFORMATION ON ATLAS AND LES 120

List of figures

FIGURE 1; ORGANIZATIONAL CHART, THE VOLVO GROUP 2
FIGURE 2; ORGANIZATIONAL CHART OF THE GLOBAL PURCHASING DEPARTMENT AT VOLVO LOGISTICS 3
FIGURE 3; THE THREE BUSINESS AREAS OF VOLVO LOGISTICS; INBOUND, OUTBOUND AND EMBALLAGE 3
FIGURE 4; ILLUSTRATION OF THE RESEARCH PROCESS 7
FIGURE 5; SUMMARY OF THE STRUCTURE OF THE THEORY CHAPTER 13
FIGURE 6; TWO DIFFERENT INTERACTION MODELS BETWEEN THE SUPPLYING AND BUYING FIRM 16
FIGURE 7; ILLUSTRATION OF THE PROCESS OF PURCHASING. SOURCE: VAN WEELE (2010). 16
FIGURE 8; INTERPRETATION OF KRALJIC'S PORTFOLIO MODEL. SOURCE: KRALJIC (1983), GADDE ET AL. (2010). 17
FIGURE 9; SUPPLIER PERFORMANCE EXPECTATIONS DEVELOPMENT HIERARCHY, SOURCE GORDON (2008) 19
FIGURE 10; RELATIONSHIP BETWEEN ALL METRICS AND THE KPIS OF AN ORGANIZATION. SOURCE: RASMUSSEN ET AL., 2009 21
FIGURE 11; SCHEMATIC PICTURE OF MEASURING A KPI BASED ON TIME 22
FIGURE 12; ILLUSTRATION OF AN AUTOMOTIVE DASHBOARD. SOURCE: (CAR LOVERS MAGAZINE, 2010) 27
FIGURE 13; THE TOP FIVE REASONS THAT DRIVE DASHBOARD INITIATIVES, BASED ON ANSWERS FROM 285 FIRMS. SOURCE: ABERDEEN GROUP (2009) 27
FIGURE 14; ILLUSTRATION OF AN EXECUTIVE DASHBOARD. SOURCE: (ANALYTICS IN MOTION, 2012). 28
FIGURE 15; ILLUSTRATION OF THE THREE MAIN FOCUS AREAS OF THE EMPIRICAL CHAPTER; SUPPLIER BASE, DASHBOARD AND THE DEPARTMENTS WITHIN VLC 32
FIGURE 16; SPEND DIVIDED BY BUSINESS AREA, 2011. 36
FIGURE 17; NUMBER OF ACTIVE CORE SUPPLIERS PER BUSINESS AREA, 2011 36
FIGURE 18; SPEND DIVIDED BY TRAFFIC MODE, 2011. 36
FIGURE 19; PIE CHART VISUALIZING THE SPREAD OF PURCHASED GOODS, 2011 37
FIGURE 20; ILLUSTRATION OF THE PRECISION MEASUREMENTS AT INBOUND. 43
FIGURE 21; ILLUSTRATION OF THE EMBALLAGE GLOBAL POOL OF PACKAGING 46
FIGURE 22; FLOW OF EMBALLAGE. 47
FIGURE 23; COMPARISON BETWEEN SUPPLIERS' ANSWER IN SUPPLIER SURVEY AND RESULT FROM SAFETY AUDITS, 2010.. 51
FIGURE 24; VISUALIZATION OF THE INFORMATION FLOW AND SYSTEM SUPPORT FOR HANDLING INVOICES. SOURCE: (VOLVO LOGISTICS CORPORATION, 2010) 56
FIGURE 25; ILLUSTRATION OF THE DECENTRALIZED SUPPLIER MEASUREMENT STRUCTURE AT VLC WHERE SEVERAL DEPARTMENTS ARE RESPONSIBLE FOR DIFFERENT MEASUREMENTS 58
FIGURE 26; ILLUSTRATION OF THE ANALYSIS PROCESS. THE FIGURE INCLUDES THE FOUR AREAS OF EVALUATION; PURCHASING OBJECTIVES AND VLC REQUIREMENTS, TECHNICAL RESTRICTIONS, CHARACTERISTICS OF KPIS AND ORGANIZATIONAL REPRESENTATION 60
FIGURE 27; ILLUSTRATION OF THE FOUR LEVELS OF INFORMATION IDENTIFICATION 64
FIGURE 28; SUMMARY OF THE CURRENT STATUS OF THE FINANCIAL RANKING MEASUREMENT; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 65
FIGURE 29; SUMMARY OF THE CURRENT STATUS OF THE SPEND METRIC; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 66
FIGURE 30; SUMMARY OF THE CURRENT STATUS OF THE INVOICE QUALITY KPI; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 67
FIGURE 31; SUMMARY OF THE CURRENT STATUS OF THE IB DELIVERY PRECISION KPI; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 67
FIGURE 32; SUMMARY OF THE CURRENT STATUS OF THE IB PICK-UP PRECISION KPI; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 68
FIGURE 33; SUMMARY OF THE CURRENT STATUS OF THE IB LEAD TIME KPI; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 68
FIGURE 34; SUMMARY OF THE CURRENT STATUS OF THE IB LEAD TIME KPI; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 69

FIGURE 35; SUMMARY OF THE CURRENT STATUS OF THE IB EMB UNLOADING PRECISION KPI; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 70
FIGURE 36; SUMMARY OF THE CURRENT STATUS OF THE IB EMB DELIVERY PRECISION KPI; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 70
FIGURE 37; SUMMARY OF THE CURRENT STATUS OF THE IB LEAD TIME KPI; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 71
FIGURE 38; SUMMARY OF THE CURRENT STATUS OF THE OB DELIVERY TARGET FULFILLMENT KPI; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. .. 71
FIGURE 39; SUMMARY OF THE CURRENT STATUS OF THE OB LEAD TIME KPI; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 72
FIGURE 40; SUMMARY OF THE CURRENT STATUS OF THE IB POD KPI; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 73
FIGURE 41; SUMMARY OF THE CURRENT STATUS OF THE OB ARRIVAL REPORTING KPI; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 73
FIGURE 42; SUMMARY OF THE CURRENT STATUS OF THE ISO 9001 MEASUREMENT; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 73
FIGURE 43; SUMMARY OF THE CURRENT STATUS OF THE ISO 14001/SMARTWAY MEASUREMENT; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 74
FIGURE 44; SUMMARY OF THE CURRENT STATUS OF THE AVERAGE MOTOR CLASS MEASUREMENT; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. .. 75
FIGURE 45; SUMMARY OF THE CURRENT STATUS OF THE CO2 EMISSION KPI; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 75
FIGURE 46; SUMMARY OF THE CURRENT STATUS OF THE CO2 EMISSION KPI; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 76
FIGURE 47; SUMMARY OF THE CURRENT STATUS OF THE CONTINGENCY PLAN MEASUREMENT; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 77
FIGURE 48; SUMMARY OF THE CURRENT STATUS OF THE TRANSPORT QUALITY AUDIT MEASUREMENT; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 77
FIGURE 49; SUMMARY OF THE CURRENT STATUS OF THE CSR COMPLIANCE MEASUREMENT; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 78
FIGURE 50; SUMMARY OF THE CURRENT STATUS OF THE OVERALL RISK MEASUREMENT; WHY IT IS IMPORTANT AND WHERE IT IS CURRENTLY STORED. ALSO A JUDGMENT ON WHETHER IT SHOULD BE INCLUDED IN THE DASHBOARD OR NOT IS PROVIDED. 78
FIGURE 51; BAR CHART DISPLAYING THE SPREAD OF KPIS BETWEEN THE DIFFERENT CHARACTERISTICS. 86
FIGURE 52; ILLUSTRATION OF THE BALANCE BETWEEN DIFFERENT CHARACTERISTICS OF THE KPIS..... 92
FIGURE 53; ILLUSTRATION OF THE DECENTRALIZED SUPPLIER MEASUREMENT STRUCTURE AT VLC WHERE SEVERAL DEPARTMENTS ARE RESPONSIBLE FOR DIFFERENT MEASUREMENTS..... 92
FIGURE 54; MIND MAP THAT COVERS ALL THE MEASUREMENTS THAT WERE FOUND FROM THE EMPIRICAL STUDY. IT SHOWS THE DIFFERENT PREREQUISITES AND CONDITIONS THAT ARE RELATED TO EACH OF THE KPIS. 94
FIGURE 55; ILLUSTRATION OF THE FOUR LEVELS OF INFORMATION IDENTIFICATION. 98
FIGURE 56; VISUALIZATION OF THE RECOMMENDED KPIS AND MEASUREMENTS FOR THE SUPPLIER PERFORMANCE DASHBOARD. 99
FIGURE 57; IMPLEMENTATION PROCESS FOR THE SUPPLIER PERFORMANCE DASHBOARD 101
FIGURE 58; ILLUSTRATION OF THE COMPLEX SUPPLIER EVALUATION PROCESS WITH SEVERAL CONTACT POINTS BETWEEN VLC AND THE SUPPLIER..... 102

List of tables

TABLE 1; REPORT DISPOSITION 5
TABLE 2; DESCRIPTION OF THE SOURCES OF DATA THAT HAVE BEEN APPLIED IN ORDER TO ANSWER THE DIFFERENT RESEARCH QUESTIONS..... 9
TABLE 3; DESCRIPTION OF WHAT THEORETICAL DATA WILL BE USED IN ORDER TO ANSWER THE DIFFERENT RESEARCH QUESTIONS. 14
TABLE 4; ILLUSTRATION OF THE FRAMEWORK FOR EVALUATING KPIS AND MEASUREMENTS 25
TABLE 5; SUMMARY OF IMPORTANT SERVICE QUALITY KPIS IN TRANSPORT OPERATIONS 26
TABLE 6; DESCRIPTION OF WHAT EMPIRICAL FINDINGS WILL BE USED IN ORDER TO ANSWER THE DIFFERENT RESEARCH QUESTIONS ... 33
TABLE 7; OVERVIEW OF THE DIFFERENT COMMODITIES THAT ARE APPLIED BY THE PURCHASING DEPARTMENT. 37
TABLE 8; STRUCTURE OF CHAPTER 4.3 AND ALIGNMENT WITH RESEARCH QUESTIONS 39
TABLE 9; SUMMARY OF PURCHASING KPIS 41
TABLE 10; SUMMARY OF INBOUND KPIS 44
TABLE 11; SUMMARY OF OUTBOUND KPIS..... 45
TABLE 12; SUMMARY OF EMBALLAGE KPIS..... 47
TABLE 13; SUMMARY OF EMBALLAGE TRANSPORTATION KPIS 48
TABLE 14; SUMMARY OF OPERATION EXCELLENCE KPIS 52
TABLE 15; SUMMARY OF RISK MANAGEMENT KPIS..... 54
TABLE 16; SUMMARY OF I&CC KPIS 57
TABLE 17; SUMMARY OF ALL POSSIBLE KPIS TO INCLUDE IN A DASHBOARD, DIVIDED WITH REGARDS TO FINANCIAL, OPERATIONAL OR CORE-VALUE ORIENTATION. 59
TABLE 18; RANKING OF THE KPIS THAT WERE IDENTIFIED IN THE EMPIRICAL CHAPTER. THE RANK RANGE FROM 1 TO 3 AND ASSESS SIX DIFFERENT CRITERIA. 80
TABLE 19; KPIS AND MEASUREMENTS CATEGORIZED AS QUALIFIED, FUTURE OR NON-APPLICABLE FOR THE SUPPLIER PERFORMANCE DASHBOARD 82
TABLE 20; DISTRIBUTION OF THE TWELVE MEASUREMENTS AMONG THE FOUR LEVELS OF SUPPLIER ASSESSMENT AS PRESENTED BY VAN WEELE (2010). 83
TABLE 21; CATEGORIZING THE KPIS AND MEASUREMENTS RECOMMENDED FOR THE DASHBOARD..... 84
TABLE 22; ILLUSTRATION OF THE DIVISION AMONGST KPIS INCLUDED IN THE DASHBOARD BETWEEN THE DEPARTMENTS AT VLC. 87
TABLE 23; EVALUATION OF KPIS ON FIT TOWARDS TRAFFIC MODES 89
TABLE 24; CURRENT AND FUTURE SYSTEM AND LEVEL OF IDENTIFICATION FOR ALL RECOMMENDED DASHBOARD MEASUREMENTS.... 97
TABLE 25; RECOMMENDED KPIS AND MEASUREMENTS FOR THE DASHBOARD. 103
TABLE 26; SYSTEMS, BOTH CURRENTLY AND FUTURE, WHERE KPIS AND MEASUREMENTS FOR THE SUPPLIER PERFORMANCE DASHBOARD IS FOUND 104
TABLE 27; CURRENT AND FUTURE LEVEL OF IDENTIFICATION OF EACH KPI AND MEASUREMENT INCLUDED IN THE SUPPLIER PERFORMANCE DASHBOARD 105
TABLE 28; RANKING OF IMPORTANT MEASUREMENT WHEN EVALUATING SUPPLIERS, ACCORDING TO PURCHASERS WITHIN THE GLOBAL PURCHASING DEPARTMENT IN GOTHENBURG..... 118
TABLE 29; SUMMARY OF ALL IDENTIFIED METRICS MEASURED WITHIN ALL INVESTIGATED DEPARTMENTS AT VLC 119

List of abbreviations

A4D	Application For(4) Distribution
APAC	Asia & Pacific
ATLAS	Advanced Transport Logistics for Automotive Supply
BAS	Business Analysis System
BI	Business Intelligence
CIC	Contracting & Invoice control
CSR	Corporate Social Responsibility
EBD	Enterprise Buyer Desktop
EDI	Electronic Data Integration
EMEA	Europe, Middle East & Africa
FADS	Forwarding Administration System
GBO	Global Business Operations
I&CC	Invoicing & Cost Control
JIT	Just-in-time
KPI	Key Performance Indicator
LES	Logistics Enterprise Solution
NAM	North Americas
NAP	Non-Automotive Products
POC	Proof of Collection
POD	Proof of Delivery
PS&S	Purchasing Strategy & Support
RFI	Request for Information
RMS	Risk Management System
SAP	Systems, Applications and Products in Data Processing
SFUR	Special Follow-Up Routine
SOP	Standard Operating Procedure
TIR	Transport Information Routines
TMR	Trigger, measureable time period and record
VBS	Volvo Business Services
V-EMS	Volvo Emballage Management System
VLC	Volvo Logistics

1 Introduction

The introductory chapter starts with a brief background to the topic of this thesis and its relevance in a broader context. Thereafter, a company background is provided followed by the purpose and the research questions. The chapter ends with delimitations and a description of the report disposition.

1.1 Background

When describing the business environment of today, emphasis should no longer be put on competition between single firms, but rather on the competition between entire supply chains (Christopher, 2005). To be successful, companies cannot operate in isolation and only rely on its own performance; they are highly dependent on the performance of other actors in the supply chain as well, not least the suppliers. The growing importance of the suppliers in a company's supply chain increases the need for supplier performance assessment (van Weele, 2010). Continuous supplier monitoring helps companies assess whether the suppliers manage to fulfill the sufficient level of performance that is required by the buying firm (Simpson, et al., 2002). In their study, Schmitz and Platts (2004) found that supplier performance measurement appeared to be an important tool among vehicle manufacturers.

Volvo Logistics (VLC) is the lead logistics provider of the Volvo group; one of the world's leading providers of commercial transport solutions. VLC has identified 154 core suppliers, accounting for 90 percent of the total spend. In order to increase the understanding of the suppliers' performances; the current status and historical development, the purchasing department at VLC desires to compile the most relevant performance metrics into a supplier performance dashboard. A large amount of data exists within the organization today but it is stored in different systems and within separate functions of the company, which means that relevant information do not reach the purchasing department.

The performance dashboard is a relatively new phenomenon that belongs to the broader concept of Business Intelligence (BI) (Rasmussen, et al., 2009). Today, BI refers to a way of combining products, technology, and methods to structure key information that management requires in order to improve profit and performance (Williams & Williams, 2007). The main intension behind the supplier performance dashboard for the purchasing function of VLC, is that it should be a supportive tool and a central element of a new Supplier management forum. The dashboard will visualize the most relevant information regarding each core supplier to make it possible to identify deficient performance and recognize potential areas of improvement. The dashboard should also be of a generic nature in order to increase the applicability for different contexts.

Baily et al., (2005) emphasize the importance to align the purchasing strategy with the corporate strategy and the overall goals. Thus, it is essentially important that the performance indicators included in the dashboard are chosen carefully in order for them to be relevant in the specific context and ensure that the right criteria are considered when making the supplier evaluations.

1.2 Company background – the Volvo Group

The Volvo Group was founded in 1927 by Gustaf Larson and Assar Gabrielsson, in Gothenburg, Sweden. Today, the company is a world leading provider of commercial transport solutions including products such as; trucks, buses, engines, construction equipment, aircraft engine components and drive shafts for boats and industrial applications as well as financial solutions and an increasing number of other services (AB Volvo, 2012). The Volvo Group employs approximately 100 000 people with production facilities in 19 countries and sales activities in totally 180 different markets with Net sales for 2011 of 310,367 MSEK and an Operating income of 26,899 MSEK (Volvo Group, 2012)

The Volvo Group operates according to three core values; safety, quality and environmental care. These values are an important part of the corporate culture and they serve as a foundation to the company's products and operations. Volvo aims at maintaining a leading position within these areas (AB Volvo, 2012).

The organizational chart in figure 1 illustrates the Volvo Group and its operations according to the new organizational structure that was introduced 2012. The first five operations from the left hand side constitute Volvo Group Trucks where all functions related to trucks are gathered. Within Volvo Group Trucks, sales and marketing is divided into three regions; Americas (both north and south), EMEA (Europe, Middle East and Africa) and APAC (Asia and Pacific) as well as Technology and Operations. Besides Volvo Group Trucks, the operations of Volvo Construction Equipment, Finance and Business Support as well as the business areas of; Volvo Penta, Volvo Aero, Volvo Buses and Governmental Sales is included in the organizational chart (AB Volvo, 2012).

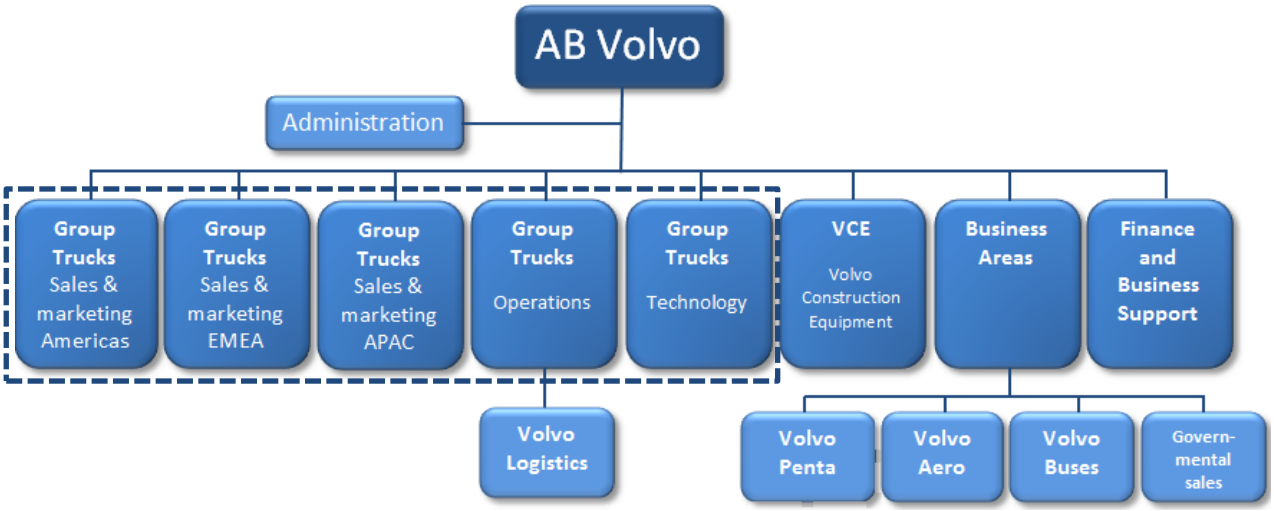


Figure 1; Organizational chart, the Volvo Group

1.3 Company background – Volvo Logistics

Within Operations under Volvo Group Trucks in figure 1, VLC is found. This subsidiary develops and provides its customer, the automotive and aerospace industry both within and outside the Volvo Group, with adapted transportations and logistics solutions throughout the entire supply chain on a worldwide basis. These solutions include packaging, complex logistics solutions and systems, insurance as well as distribution solutions for finished products (AB Volvo, 2012). VLC is the old name of the organization and in connection with the re-organization; VLC will be merged with Volvo Parts

under the name of Logistic Services. Since the thesis work was initiated before the new organization was implemented, the investigation and the associated findings will be presented according to the old organizational structure and the company will be addressed as Volvo Logistics.

This master thesis is conducted within the Global Purchasing function of VLC, located in Gothenburg, Sweden. The function has around 60 employees spread over 13 countries (AB Volvo, 2012). The organizational chart for the Global purchasing department and its seven departments is shown in figure 2 and the master thesis work is organized within the Purchasing Strategy & Support department (PS&S).

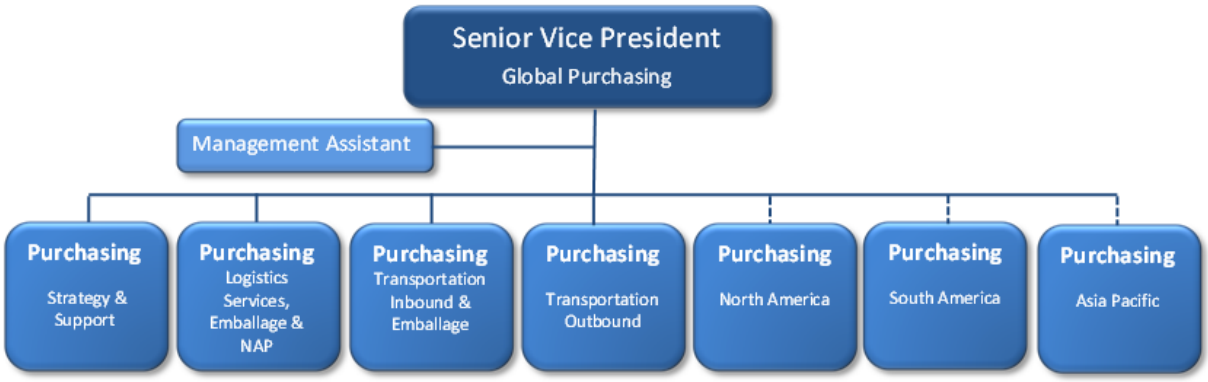


Figure 2; Organizational chart of the Global Purchasing department at Volvo Logistics

VLC is organized around three main business areas; Transportation Inbound & Emballage (Inbound), Outbound and Logistics Services, Emballage & NAP (Emballage). Inbound is the purchasing department responsible for transportation procurement of components in to the production facilities whereas Outbound procures transportation of finished products from the production facilities to dealers. The Emballage & Logistics services department on the other hand, purchases several logistic services and material for packaging to be used within both Inbound and Outbound, see figure 3 for visualization of the three business areas. Across the three business areas, the purchasing is also divided into 21 different commodities (AB Volvo, 2012). VLC has currently about 887 suppliers in the supplier base but only 17 percent, 154 suppliers are considered to be core suppliers as they account for almost 90 per cent of the annual turnover.

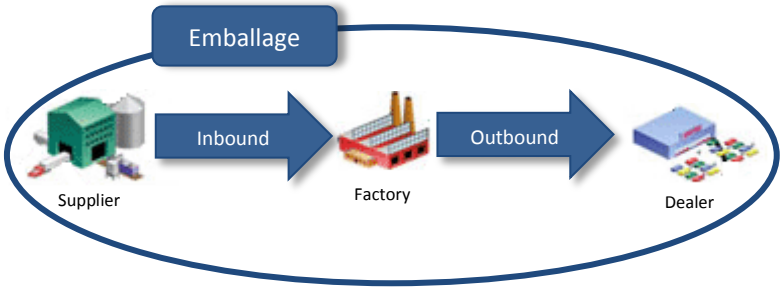


Figure 3; The three business areas of Volvo Logistics; Inbound, Outbound and Emballage

1.4 Purpose

The aim of the master thesis is to perform a pre-study of a supplier performance dashboard; to investigate what KPIs and other measurements that should be included in the dashboard. The dashboard should function as tool for visualization of supplier performance, to support accurate supplier assessments and allow fact based decision making within several areas at the strategic level of the global purchasing function of VLC.

1.5 Problem analysis and research questions

The main issue within the purchasing function of VLC that the supplier performance dashboard is intended to address is that data about supplier performance is not easily accessible, particularly in the case of operational performance. It is known that a larger part of the information is measured and stored somewhere in the organization today, but there is no exact view of what information exists and it is not possible to get a holistic view of a supplier's level of performance within the most relevant aspects. By replacing gut feeling with facts, the conditions for more efficient decision making should increase. Furthermore, a supplier performance dashboard is intended to detect deficient performance and identify potential areas for supplier performance improvement. The main requirements of the supplier performance dashboard as expressed by VLC are:

- Provide a holistic view of the most important measurements of a supplier's performance.
- Be generic in order to be easy to grasp and to be applicable in different contexts.
- Have a global coverage as far as possible.
- The implementation of a dashboard should be feasible and not require too many resources.

In order to understand the processes of supplier evaluation at VLC and what requirements they have on their suppliers, it is important to map the current situation; what evaluation practices are used today, how frequently they are performed and to what extent this information is shared, between the departments and with the suppliers. Therefore, to find an answer to the following research question is relevant:

1. *How is the supplier performance evaluation process currently carried out at VLC?*

Baily et al., (2005) emphasize the importance to align the purchasing strategy with the corporate strategy and the overall goals. Therefore, it is essentially important that the performance indicators included in the dashboard are chosen carefully in order for them to be relevant in the specific context and the right criteria are considered when making the supplier evaluations. This also means that the chosen Key Performance Indicators (KPIs) and measurements should represent the complex organizational structure by the inclusion of measurements and KPIs from all relevant departments. The KPIs and measurements included in the dashboard should be evaluated according to different characteristics and requirements. This reasoning should be kept in mind when answering the second research question:

2. *What performance indicators should be included in the Supplier performance dashboard?*

Based on the findings in the previous questions, it is important to further investigate where the information is stored and how the data can be accessed. Some of the relevant information for the dashboard is accessible through the purchasing department's current supplier assessment work. However, important information intended for the Supplier performance dashboard does not reach the purchasing department at VLC today. A large amount of data is measured and stored in different information systems in different departments and operations within VLC and it is essential to map what data is measured, how it is measured and where it is stored. The answers to the last research questions aim to clarify where the relevant data can be found and how to identify it.

3a. Where is the information relevant for the Supplier performance dashboard stored?
3b. How can the information relevant for the Supplier performance dashboard be identified?

1.6 Delimitations

It is not within the scope of this thesis to technically create, or program a dashboard, but to develop recommendations and guidelines for how the dashboard should be designed and from where to collect data. Furthermore, the technical solutions required for transferring of data between different systems will not be covered in this thesis.

The measurements considered for inclusion in the dashboard are all KPIs and metrics currently measured within the VLC organization. Suggestions or recommendations on inclusion of metrics not measured today within the VLC organization will therefore not be made.

The overall discussion regarding supplier performance evaluation and the use of dashboards as a tool to achieve this is general and will be applicable to other organizations. However, the more detailed information regarding empirical findings within the different departments of VLC is more difficult to generalize to other areas of application.

1.7 Report disposition

This thesis is structured with seven different chapters, each with a specific focus and different purposes to be fulfilled. The different chapters and their focus are presented in table 1 below:

Table 1; Report disposition

Chapter	Objective
Chapter 1; Introduction	The first chapter provides an introduction to both the purpose of the thesis, the research questions, the concept of a dashboard and the Volvo group
Chapter 2; Methodology	The methodology chapter provides information on the research methodology as well as the process used while writing this thesis
Chapter 3; Theoretical findings	Within the theory chapter, the reader will gain background information regarding purchasing and supplier assessment in general and more detailed information regarding the subjects of performance measurements and business intelligence in particular.
Chapter 4; Empirical findings	The empirical chapter describes the current state of supplier assessment within VLC. The chapter is structured around three main areas of investigation; dashboard requirements; the supplier base and the supplier measurements performed within the departments of VLC.
Chapter 5; Analysis	The findings within chapter 3 and 4 are merged within the analysis chapter where the research questions are analyzed. This chapter contains the evaluation of possible KPIs for the dashboard as well as visualization
Chapter 6; Conclusions	The conclusions in chapter 6 will answer the research questions presented in chapter 1 together with other conclusions and findings relevant for VLC, made in the process of this thesis
Chapter 7; Recommendations	In chapter 7 recommendations for VLC on how to design and proceed with the supplier performance dashboard is given
References	The list of references provides the reader with all information on the sources of the literature used within this report
Appendices	The appendices contains information such as list of interviewees, interview guides and other information relevant for this thesis

2 Method

This chapter presents information regarding the research methodology used in order to perform this master thesis as well as the data collection and where information is gathered. Generic information is presented on chosen research approach and the process used throughout the thesis work is also presented in both figures and text. The compilation of the information presented, will provide a chain of evidence for validation of the thesis result.

2.1 Qualitative research approach

This master thesis has been based on a qualitative research strategy; a method that emphasizes meanings expressed in words rather than numbers when it comes to collection and analysis of data (Bryman & Bell, 2003). It is a typical approach when there is a need to uncover and gain deeper insight into a specific phenomenon (Ghauri & Grønhaug, 2005). In this specific case, the phenomenon to further evaluate is supplier assessment and the creation of a supplier performance dashboard. Since the findings of this study has been shaped by the authors' deeper understanding of the operations at VLC and the specific requirements regarding supplier performance measurement, a qualitative approach is most appropriate. Qualitative data is associated with richness and thorough descriptions that have the potential to provide a broader picture of a phenomenon (Saunders, et al., 2009). It means that the qualitative strategy has the potential to provide as a holistic view of the logistics operations within the Volvo Group as possible, since the strategy allows for evaluation and combination of different perspectives that exist in different parts of the organization.

In the qualitative approach, the general procedure is not to conduct hypothesis tests against established concepts and theories, but more often it appears that new concepts and theories emerge from the study (Bryman & Bell, 2003). However, that is not always the case; theory is commonly used also in qualitative research, especially to provide a background to the qualitative study (Bryman & Bell, 2003). Theoretical literature about more general concepts regarding purchasing and supplier assessment, and specific information regarding performance measurements and business intelligence has been used in this master thesis to provide an input to the analysis of the empirical data.

Several research methods are categorized as qualitative methods; interviews and focus-groups are two examples (Bryman & Bell, 2003) and interviews have been the primary source of qualitative data for this thesis. This master thesis has been carried out as a case study; an in-depth study of VLC with specific focus on its global purchasing department. A case study is appropriate when the object of investigation is difficult to examine outside its natural setting and when there are many concepts and variables to consider which are hard to quantify (Ghauri & Grønhaug, 2005). The case study approach is also preferable for theory development and testing and is appropriate within the qualitative research strategy (Ghauri & Grønhaug, 2005). This approach is therefore preferable for the study at VLC where the result will depend on the observations and collection of information within the company setting. Since there is no previous research to compare the findings at VLC with, a case study is also appropriate since the study will result in new developed theories.

2.2 The research process

Figure 4 illustrates the research process, from the iterative problem definition procedure to the final recommendations. As seen on the left-hand-side, the three different stages of literature review, analysis and conclusion is illustrated. The stages are interrelated and the process described in the middle is continuously carried out through the tasks presented on the right-hand-side.

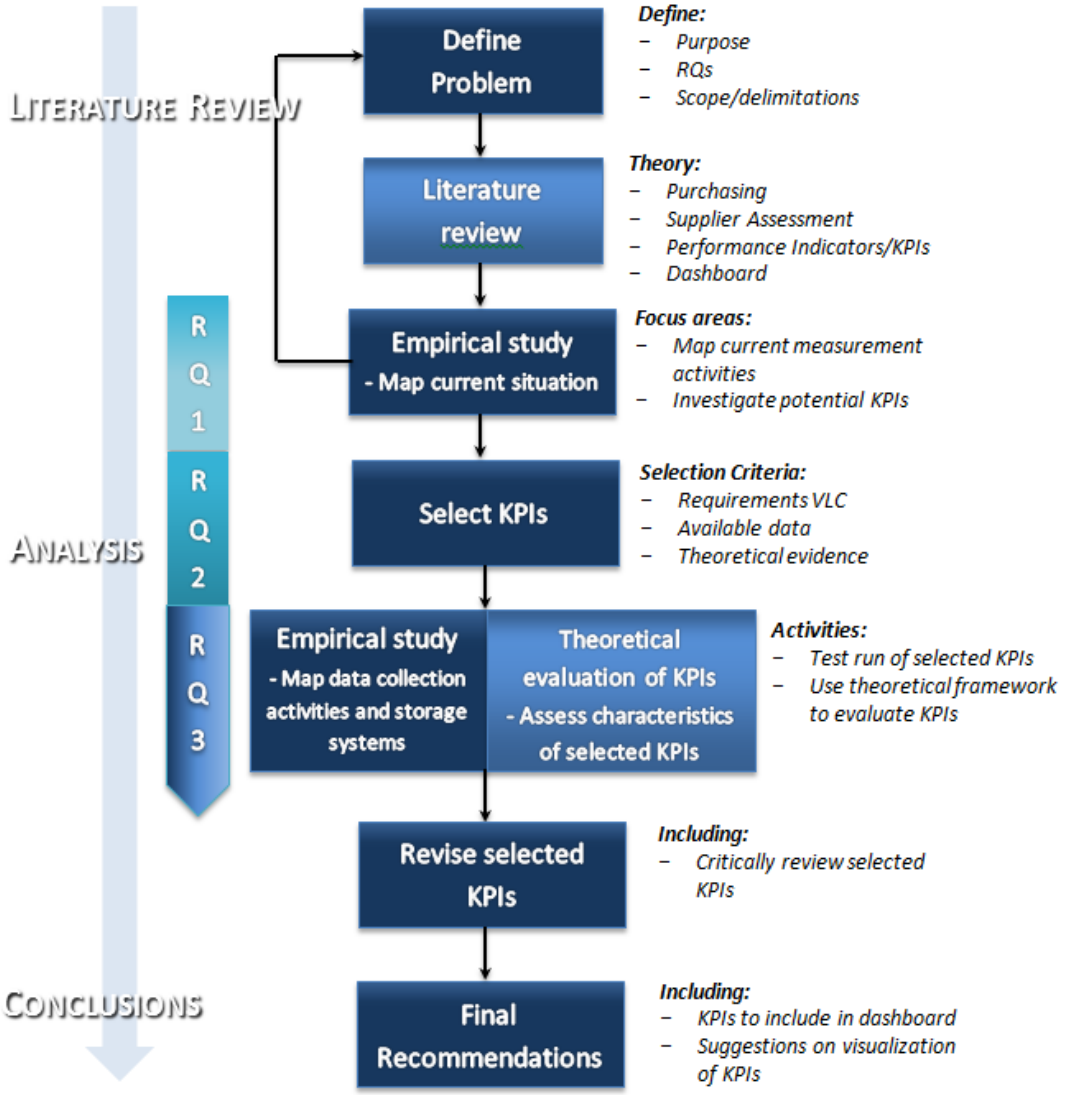


Figure 4; Illustration of the research process.

2.3 Exploratory, descriptive or explanatory approach

The research design of a study can be classified as exploratory, descriptive or explanatory. Exploratory investigation is appropriate when the research problem is unstructured. It is a flexible approach that is adaptable to new conditions; the path towards problem solving may change during research project execution as new information is revealed (Ghauri & Grønhaug, 2005). The initial focus is often broad but then narrowed down during the research process (Saunders, et al., 2009).

The descriptive approach on the other hand, requires a clearly structured problem that is well understood prior to data collection (Saunders, et al., 2009). Procedures for how to collect the data must be thoroughly prepared in order to minimize variation in the data collection (Ghauri &

Grønhaug, 2005). The third approach, explanatory, or casual research, seeks to find casual relationships between variables (Saunders, et al., 2009). The purpose is to identify and isolate causes in order to determine to what extent a specific cause results in an effect (Ghauri & Grønhaug, 2005).

This study has, to a large extent, been characterized by an exploratory approach as the different issues related to the research problem are not revealed from the beginning. A part of our study is to investigate what type of data is stored within different computer systems within VLC; information that will determine the possibilities for the creation of a supplier performance dashboard. It means that some issues may be solved, while others occur during the process; the research direction will change as new information is revealed until it eventually leads to the final findings and recommendations on the design of the dashboard.

2.4 Research strategy

The qualitative research approach used in this thesis, as described in chapter 2.1 is often connected to the inductive strategy when linking data and theory together (Bryman & Bell, 2003). The inductive strategy, which has been used throughout this report, is one of two possible strategies where the other is the deductive approach. In the inductive strategy, a theory is the outcome of the research performed. From the empirical observations and findings discovered, generalized conclusions are made and the outcome of the research performed will result in a theory (Bryman & Bell, 2003; Ghauri & Grønhaug, 2005). The deductive strategy on the other hand, describes the relationship between theory and research; an initial hypothesis is empirically inspected and the theory guides the research (Bryman & Bell, 2003).

Another wording is that deduction is based on logic whereas induction is based on empirical evidence (Ghauri & Grønhaug, 2005). Although this thesis is built upon the inductive strategy, deductive parts have been included. This is a natural way where inductive elements are performed within the deductive strategy and the other way around (Bryman & Bell, 2003; Ghauri & Grønhaug, 2005). That the inductive approach is the main one within this thesis is seen in the structure of the report, where theoretical and empirical findings form the basis for analysis and drawings of general conclusions.

2.5 Data collection and data analysis

The data that has been used in this master thesis consists of both primary and secondary sources of information. Primary data is collected for a particular case and can be gathered through experiments, observations, surveys and interviews (Ghauri & Grønhaug, 2005). In this study, interviews have formed the basis for the primary data. Interviews has been chosen as the primary source of information since it allows for a deeper investigation into the supplier performance evaluation conducted at the different departments at VLC, in a way that standardized surveys would not be able to provide.

The secondary data has been collected through an extensive literature review including academic journals, books and carefully chosen trade magazines. Internal documents and annual reports of AB Volvo has also been useful material for the gathering of secondary data. One advantage of secondary data is that it saves time and money; it facilitates the understanding of the research problem and enhances the reliability of the research findings (Ghauri & Grønhaug, 2005). In contrast, a disadvantage presented by Ghauri and Grønhaug (2005) is that the secondary data may not fit the

specific problem; therefore, it is important to identify what particular information is needed and gather data from that perspective. Table 2 illustrates what type of data that has been collected and applied in order to answer each research question.

Table 2; Description of the sources of data that have been applied in order to answer the different research questions.

Research Question	Theoretical evidence	Empirical evidence
RQ 1: How is the supplier performance evaluation process currently carried out at VLC?	- Literature on purchasing in general and supplier assessment and evaluation in particular.	- Interviews with employees within different relevant departments within the VLC organization. See appendix 1 and 2 for further details. - Review of internal documentation - Observations
RQ 2: What performance indicators should be included in the Supplier performance dashboard?	- Information regarding performance measurements and a compilation of transportation related performance measurements presented in academic literature. - Present characteristics and other detailed information regarding performance indicators. - Relate to the general responsibilities of the purchasing function and investigate whether a dashboard is relevant for the objectives of the purchasing function or not. - Also include literature on the design of dashboards and the broader scope of Business Intelligence.	- Thorough interviews within VLC; map what is actually measured within VLC today and verify that data is accessible and consistently defined. - Relate to corporate strategy and goals -Interviews with buyers and key users/stakeholders of the dashboard to clarify basic requirements - Interviews with suppliers to gain insight in their attitude towards a Supplier performance dashboard and to investigate possible transformation of data from the supplier through self-reporting.
RQ 3a: Where is the information relevant for the Supplier performance dashboard stored?	N/A	-Interviews with employees within relevant departments of VLC to identify in what systems and what format different measurements are stored
RQ 3b: How can the information relevant for the Supplier performance dashboard be identified?	N/A	-Interviews with employees within relevant departments of VLC to identify how the performed measurements are linked to suppliers and what type and level of identification are used.

2.5.1 Literature review

In order to deepen our understanding of the research topic and to map previous research within the field, an extensive literature review has been carried out. Academic journals in databases accessed through the library of Chalmers University of Technology and books written by recognized experts have been the primary sources of literature. As the concept of supplier performance dashboards is relatively new and the subject has not yet been explored to any larger extent in scientific research, but still, has attained considerable interest among managers and consultants, trade magazines and Internet webpages have been studied in order to broaden our understanding of the most recent trends.

The search for literature began in a broad scope where the findings helped us gain a basic knowledge regarding the subject. When searching for academic articles, different approaches have been applied. Free searches in the databases with the following key words have been one approach; *logistics purchasing, supplier assessment, supplier performance dashboard, performance indicators and Key Performance Indicators.* A more systematic strategy has also been applied; to examine relevant journals ten years back in time in order to find applicable literature. The findings have then been scanned, categorized and analyzed in order to narrow the scope and pick the most interesting literature for a more in-depth learning. This literature have also formed the foundation of chapter three, the theory chapter; the framework that have been the basis for the analysis of the empirical data.

As a part of the empirical investigation internal documents provided by VLC concerning previous and current supplier assessment work and supplier contracts has been studied. Official documents about supplier requirements accessed through the Volvo Group homepage have also been examined. These documents has been valuable since it have deepen our understanding of the core values of the Volvo Group and to understand which supplier performance measures are most important in their organization.

2.5.2 Interviews

To get an understanding and gain empirical data of the current situation at the Global purchasing department as well as other departments within Volvo Logistics that have information needed for the supplier performance dashboard, a number of interviews have been carried out. In the start-up of the thesis work, interviews of a more unstructured nature have been carried out as a pre-study to gain basic knowledge of the organization and the expectations on the supplier performance dashboard, more general interview guides have been formalized for these interviews due to their unstructured nature.

The pre-study interviews have been followed by interviews held with relevant employees from the functions within the different departments that hold information needed for deeper knowledge or to create and design the supplier performance dashboard. In total, interviews with 35 interviewees have been conducted in order to find empirical evidence for this thesis. For a list of interviewees, see appendix 1. These interviews have been qualitative semi-structured, which means that they have been structured to a certain degree but the structure also gives the interviewees the opportunity to speak freely about the issues discussed (Bryman & Bell, 2011). The tape recordings from the interviewees have received the main questions or interview guide in beforehand, in order for them to access relevant information from within their department before the interview. A generic

template of the interview guides is found in appendix 2, in addition to these generic questions more specific and detailed questions may have been added to each different interview. The interviews have been tape-recorded and notes have also been taken throughout the session, since this combination is seen as the most useful when collecting data (Ghauri & Grønhaug, 2005). The interviews have also been transcribed to make sure that no information is lost in translation. Due to secrecy issues, the names of all interviewees as well as suppliers discussed will remain anonymous throughout this report.

Interviews have also been conducted with a small number of selected suppliers in order to gain an understanding of their overall attitude towards a supplier performance dashboard and the possibilities to exchange data. These interviews have taken place in the later stage of the thesis process when the concept regarding the supplier performance dashboard are formed and can be discussed with the selected suppliers. The suppliers have been selected among the top suppliers within the business areas of Inbound and Outbound as well as a spread between different traffic modes. The interview guide used for these interviews is of a more standardized nature then the ones used within VLC and the responses have been gathered through mail conversations, telephone meetings as well as personal meetings. See appendix 3 for an anonymous list of interviewed suppliers and an interview guide with questions.

A set of questions have also been sent via e-mail to the purchasers located at the Gothenburg office in order to investigate which KPIs and measurements they find most important when evaluating a supplier. The purchasers were asked to rank the most important KPIs and measurements according to the interview guide found in appendix 4, where also the results of the survey are presented. As for the interview guide used for the interviews with the top suppliers, this interview guide is more standardized compared to the ones used during the interviews with internal employees.

2.6 Validity and reliability

An aspect to consider regarding the research result is that the obtained knowledge is valid and that the results are true, something that can be measured through the reliability and validity of the report (Ghauri & Grønhaug, 2005). These are different types of measures of the rigor, quality and further potential of the research (Bryman & Bell, 2003).

Validity refers to that performed measurements captures what they are supposed to do (Ghauri & Grønhaug, 2005) or that observations, identifications or measurements are what they say it is (Bryman & Bell, 2003). Since numerical measurements are not a part of this qualitative study, Bryman and Bell's (2003) definition of observation and identification is more appropriate to apply to this study. They state that validity can be categorized as either internal or external, where the internal validity means that there is a good match between the theoretical ideas developed and the researcher's observation (Bryman & Bell, 2003). According to Ghauri and Grønhaug (2005) internal validity means that the results derived within the study is true.

External validity on the other hand, deals with the possibility of generalizing the findings from the research. Such generalization could be for other populations or time periods leading to the importance of sample procedures in quantitative studies (Ghauri & Grønhaug, 2005). In qualitative studies, external validity instead, deals with generalization of the findings across social settings; it may become a problem when the findings are derived from small and precise case studies (Bryman &

Bell, 2003). For this report, the validity in general and the external validity in particular need to be determined from the scope of the case study. The performance of suppliers investigated is for services and logistic services in particular, leading to a generalization possible within these fields.

The reliability refers to the stability of the measures (Ghauri & Grønhaug, 2005) and external and internal reliability is found here as well. The external reliability refers to what degree a study can be replicated and more useable within quantitative studies (Bryman & Bell, 2003). For qualitative studies like this one, it is harder to replicate the study due to the impossibility of freezing a social setting or find an exact replica where the study can be performed again. However, the internal reliability is more applicable to this report since the research team consists of two people and that internal reliability means that the members of the research team is in agreement of what is said and heard (Bryman & Bell, 2003).

2.6.1 Validity and reliability in the literature review

To ensure the validity and reliability of the literature review included in this thesis, the data used are from trustworthy sources. The majority of the data is found through the databases provided by the library of Chalmers University of Technology and seen as credible. The published articles are also taken from journals within the studied field in order for the information to be accurate and applicable to our purpose. When data is gathered from other sources than acknowledged scientific databases, the information is examined carefully to make sure that the authors do not provide a biased viewpoint and if so, that the topic at hand is viewed through other sources as well.

2.6.2 Validity and reliability in the interviews

For the interviews conducted, the validity and reliability is ensured mostly through the agreement between the authors on what has been said and done. When each interview is finished, a specific time period is set-aside in order for the interviewers to individually evaluate and jointly discuss on what the interviewee stated. As mentioned earlier, all interviews have been recorded and the tape-recordings have been transcribed, besides the notes taken during the interview in order to guarantee that no details are lost.

3 Theoretical framework

The theoretical framework presented in this chapter will provide the basic knowledge within the topic of this thesis as well as serve as the basis for the analysis of the empirical findings in chapter 4. The structure of the theoretical framework can be compared to a funnel, see figure 5. Each of the four layers of the funnel corresponds to a sub-chapter within the theoretical framework.

At the top the scope of the presented theory is broad and purchasing in general and purchasing of services and logistic services in particular, providing background knowledge to the reader, will be presented. As the funnel narrows, the theory is concentrated to a part within the purchasing function, the assessment of the suppliers. The next step within supplier assessment is performance measurements and this sub-chapter will provide general theory on performance measurements as well as the inclusion of a framework on how to evaluate KPIs. In the bottom of the funnel, the scope is narrow and concentrated to Business Intelligence (BI).

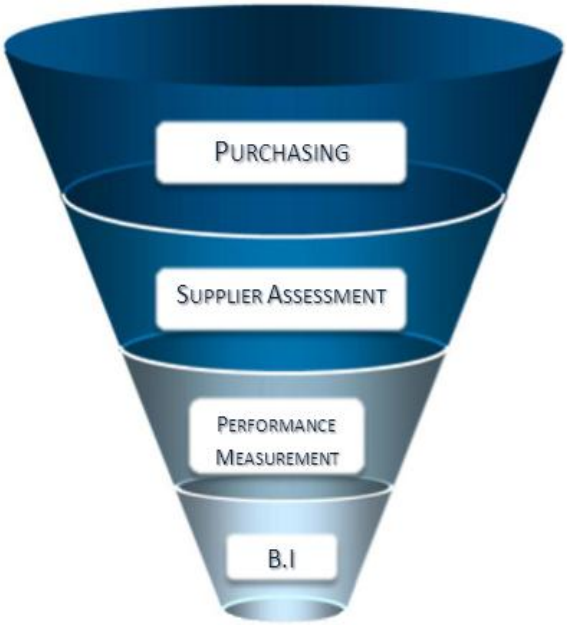


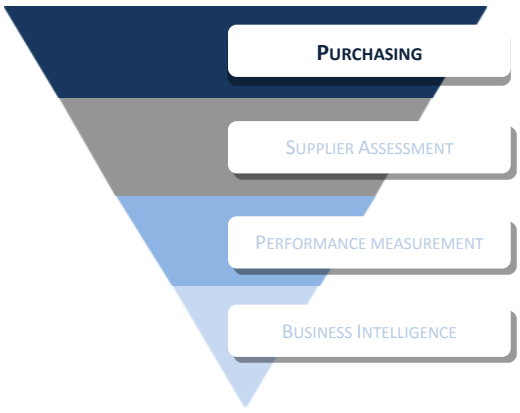
Figure 5; Summary of the structure of the theory chapter.

This section of the theoretical framework will provide information on how to use and visualize the KPIs chosen from the performance measurements, and the concept of an executive dashboard will be presented in more detail. Theory regarding the research questions of this thesis will be presented in different part of this chapter. See table 3 below.

Table 3; Description of what theoretical data will be used in order to answer the different research questions.

Research Question	Theoretical evidence
RQ 1: How is the supplier performance evaluation process currently carried out at VLC?	- Literature on purchasing in general and supplier assessment and evaluation in particular. - General structure of the buyer-supplier relationship and related complexities. - Description of the theoretical buying process and in which stage(s) the dashboard may be relevant. - Description of what is meant by supplier assessment in order to compare the appropriateness of a dashboard in this context.
RQ 2: What performance indicators should be included in the supplier performance dashboard?	- The objectives of purchasing which are directly related to the requirements on the dashboard and what information to include. - Characteristics of performance measurements to clarify what different types of measurements that are described in theory. - Identification of transportation related performance measurements in academic literature. - Also include literature on the design of dashboards and the broader scope of Business Intelligence. - Description of the benefits and potential pitfalls of a dashboard in order to adjust the information to avoid the pitfalls and utilize the benefits.
RQ 3a: Where is the information relevant for the Supplier performance dashboard stored?	N/A
RQ 3b: How can the information relevant for the Supplier performance dashboard be identified?	N/A

3.1 Purchasing



Purchasing is traditionally described as the function that performs the process of buying; from identifying the needs to ensuring final delivery of product or service (van Veele , 2005). Van Veele (2005) defines purchasing as: "The management of the company's external resources in such a way that the supply of all goods, services, capabilities and knowledge which are necessary for running, maintaining and managing the company's primary and support activities is secured at the most favorable conditions". The following list is presented by Baily et al. (2005) and includes the main objectives of the purchasing function:

- To meet the needs of the organization through supply of materials and services.
- To maintain effective relationships with existing suppliers and develop alternative sources of supply in order to ensure continuous supply.
- To buy efficiently and wisely. With ethical means, obtain the best value for the money spent.
- To maintain cooperative relationships with other departments; ensure effective operations of the company as a whole through sharing of information and advices.
- To develop staff, policies, procedures and organization to ensure achievement of the objectives.

The authors are also describing some more detailed objectives of purchasing (Baily, et al., 2005):

- To select the best suppliers in the market.
- To support effective development of new products.
- To look after the company's cost structure.
- To maintain a correct balance between quality and value.
- To monitor supply market trends.
- To negotiate effectively in order to collaborate with suppliers who seek mutual benefit through economically superior performance.
- To perform supply management in an environmentally responsible way.

The importance of purchasing has steadily increased in recent years and many organizations of today see it as a function of considerable strategic importance (Baily, et al., 2005). As companies increasingly focus on its core competencies, fewer activities are performed in-house which means that the purchased value accounts for an even larger share of the total cost of goods sold (Baily, et al., 2005; van Veele , 2005). In the automotive industry, purchased goods and services constitute approximately 60 to 80 percent of the total cost of goods sold (Baily, et al., 2005; van Veele , 2005). Not only increasing expenditures, but also fewer but larger suppliers, environmental awareness, customer demands, advancing technology and finite resources are mentioned as some additional factors that have contributed to increased strategic importance of purchasing (Baily, et al., 2005).

An additional trend within purchasing is that relationships to the suppliers have moved from arm's length to closer, mutual relationships. In mutual relationships, both parties invest confidence and support with the intension to add value; something that cannot be achieved in a simple transaction in an arm's length relationship (Baily, et al., 2005). However, it is not convenient for companies to have close relationships to all of its suppliers. Instead, closer relationships are sought with the strategically most important suppliers, often those actors that perform most business with the buying firm. These suppliers can be identified with the Pareto rule; the 20 percent of suppliers that accounts for approximately 80 percent of the company's expenditures.

The relationship between the supplying and buying firm may also become more complex with additional interaction points within the interface between the two firms. The butterfly diagram displayed to the left in figure 6, illustrates only one interaction point whilst the diamond-shaped diagram, to the right in figure 6, displays an interface with several different interaction points amongst the two firms (Smith & Fitch, 2009).

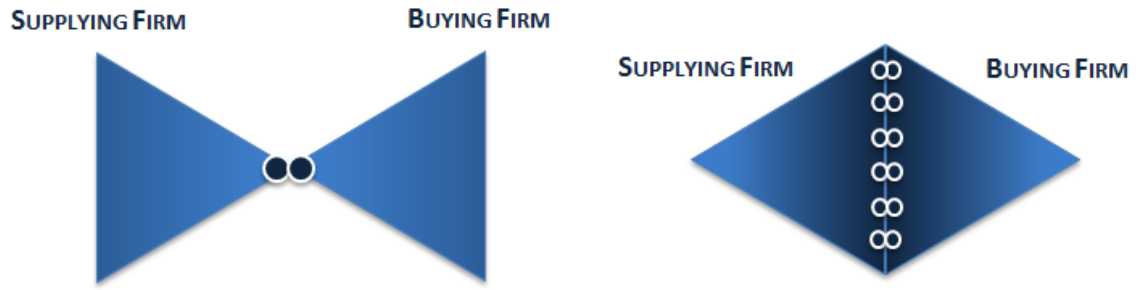


Figure 6; Two different interaction models between the supplying and buying firm.

The purchasing process has been described by van Weele (2010) to include six steps as described in figure 7. The main focus of this thesis is put on the last step; evaluation. However, some elements that are utilized for supplier evaluation in the last step can also be used for assessment in the second step; select supplier.

Figure 7; Illustration of the process of purchasing. Source: van Weele (2010).

3.1.1 Procurement of Services

According to van der Valk and Rozemeijer (2009), the way of illustrating the buying process as seen in figure 7 above, is also applicable to the procurement of services. It is useful to distinguish between purchasing of goods and purchasing of services though, as there are some important differences between the two. Goods and services differ in nature, the first is tangible, the second is intangible, to mention the most obvious difference. Bergman and Klefsjö (2010) describe the most prominent features that distinguish services from products to be:

- Services are intangible which makes it hard to define and measure the service contents
- The customer often participates when the service is created
- Services are consumed at the point of delivery and they are therefore, not storable or possible to transport
- After the service has been delivered, the customer does not become owner of anything
- Since the service consists of activities, it cannot be tested prior to purchase
- Services often consist of a package of subservices but when the customer assesses the performance of the provider, the system is assessed on an overall level, not the sub services separately

Although the purchasing process of goods and services can be considered to include similar steps (van der Valk & Rozemeijer, 2009), the difference in characteristics between goods and services affects the conditions for performing the different steps in the process (Baily, et al., 2005). Since services are not storable, thorough planning is required to make sure that the service is provided at the right time and at the right location where it is needed. If the demand for a service is difficult to predict, the task to plan the provision gets increasingly complex and it often requires large investments in standby resources (Baily, et al., 2005). Furthermore, it is difficult to test the service prior to purchase, since the results are not seen until consumption. Therefore, preliminary assessment is more focused on the service provider than on its services (Baily, et al., 2005).

Logistics belongs to the more commonly bought services (Baily, et al., 2005) and most of the characteristics of procurement of services, also apply to logistics purchasing (Andersson & Norrman, 2002). However, according to Andersson and Norrman (2002), there are some important differences between logistics services and general services:

- One difference is that the types of relationships in logistics are often of a business-to-business character. It means that it is not only the buyer that may be affected by bad service by the service provider; it can also negatively affect the operations of the buyer's customers.
- In addition, it is often a need for close interaction, both with the processes of the client and also with the processes of the client's customers.

3.1.2 Supplier base analysis

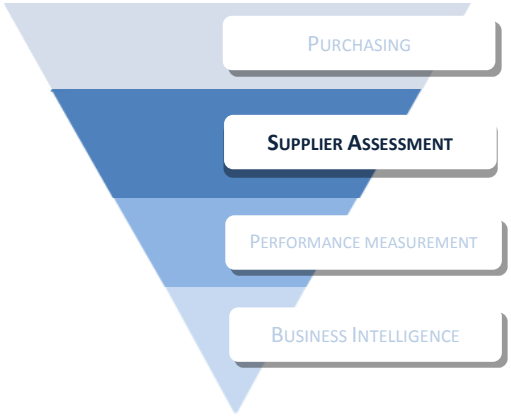
All suppliers of a buying firm constitute the company's supplier base and it is considered to be one of the most important resources of the company (Gadde, et al., 2010). A firm may have thousands of suppliers in its supplier base and it often has different types of relationships to different suppliers (Skjøtt-Larsen, et al., 2007). In order to find a structured and efficient way of managing the suppliers, a portfolio analysis of the supplier base is a useful approach (Skjøtt-Larsen, et al., 2007; Gadde, et al., 2010). One of the more well-known portfolio models was introduced by Kraljic in 1983 but his original idea has been interpreted and modified by researchers in later years (Skjøtt-Larsen, et al., 2007).

In Kraljic's portfolio model, purchasing transactions are divided into four different categories based on two dimensions (Skjøtt-Larsen, et al., 2007). The vertical dimension in the matrix is importance of purchasing, which means what impact the purchased product or service has on the business; its strategic importance and value added to the final product or service. The horizontal dimension of the matrix is complexity of supply market; the number of actors i.e. potential suppliers of the market, monopoly situations, short-term and long-term availability, materials scarcity etc. (Kraljic, 1983). Assessment of these two variables may help companies find appropriate strategies to reduce supplier risk and exploit purchasing power (Kraljic, 1983). In a portfolio analysis, purchased items can be derived to either one of the four different categories in the Krajlic model. High risk, high important items are denoted strategic products and low risk, low important items are described as non-critical. The high important, but low risk items are called leverage while low importance, high risk items are denoted bottleneck, as described in figure 8.

Figure 8; Interpretation of Kraljic's portfolio model. Source: Kraljic (1983), Gadde et al. (2010).

To handle the challenge of a diverse and complex supplier base, a portfolio analysis is an important step (Gadde, et al., 2010). It allows companies to develop individual supply strategies for particularly critical items; the approach provides an effective framework for collecting marketing and corporate data and forecast future supply scenarios (Kraljic, 1983).

3.2 Supplier assessment



As companies increasingly strive to reduce their supplier base and seek closer, long-term relationships to chosen suppliers, certain expectations are also put on those suppliers to deliver according to a sufficient level of performance (Simpson, et al., 2002). In order to monitor and control that requirements are met, companies use performance measurement to manage their supplier base (Schmitz & Platts, 2004). In a survey by Boyson (1999), performance metrics were rated as the most efficient method for supplier assessment.

Gordon (2008) defines supplier performance management as "The process of evaluating, measuring, and monitoring supplier performance and suppliers' business processes and practices for the purposes of reducing costs, mitigating risk, and driving continuous improvement". Supplier assessment or supplier performance evaluation is then defined by Sundtoft Hald and Hellegaard (2011) as "the process of quantifying the efficiency and effectiveness of supplier action". A large part of the previous work among researchers has covered performance measurement from the intra-organizational perspective while less research has been carried out on performance measurements outside the measuring firm (Schmitz & Platts, 2004).

3.2.1 Motives for supplier assessment

The connection between efficient management of the buyer-supplier relationship and competitive advantage has been addressed by several authors (Talluri & Sarkis, 2002; Sarkar & Mohapatra, 2006; Gordon, 2008). In a study by van Laarhoven et al. (2000), it was shown that in those buyer-supplier relationships where there is a strong performance orientation and performance reviews are carried out more frequently, more successful results are achieved than in those relationships where there is less focus on performance.

Sundtoft Hald and Hellegaard (2011) mention two main purposes of supplier evaluation; to support the decision making in the buying firm and to encourage performance improvement from the supplier. A survey by the Aberdeen Group (2002) showed that 70 percent of the respondents considered supplier performance evaluation critical to their operations (Aberdeen Group, 2002). Supplier performance measurement is also important in order to decide not only the price, but the total cost of the relationship, including costs for late deliveries, damages etc. (Aberdeen Group, 2002). However, indications from the Aberdeen Group (2002) study also show how inefficient and inconsistent supplier performance measurements may harm continuous improvement initiatives as well as the organization's cost structure.

3.2.2 Supplier assessment process

Gordon (2005) presents seven steps to assess supplier performance:

1. Align supplier performance goals with organizational goals and objectives
2. Determine an evaluation approach
3. Develop a method to collect information about suppliers
4. Design and develop a robust assessment system
5. Deploy a supplier performance assessment system
6. Give feedback to suppliers on their performance
7. Produce results from measuring supplier performance

The first step, to align supplier performance goals with organizational goals and objectives is important in order to ensure that the right metrics are focused upon. Figure 9 is developed by Gordon (2008) and illustrates the logical alignment between corporate goals and supplier performance expectations.

Figure 9; Supplier performance expectations development hierarchy, Source Gordon (2008).

The importance of the sixth point has also been emphasized in the Aberdeen Group study where it was shown that those buyers who shared information on performance levels with their suppliers achieved greater improvement in supplier performance than those who kept the data to themselves and instead, used it for punitive measures (Aberdeen Group, 2002).

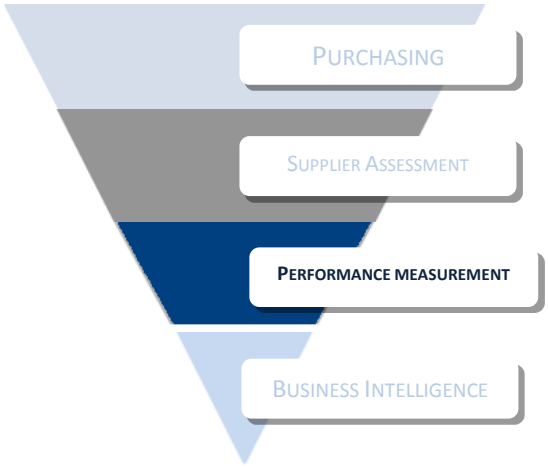
Supplier performance can be assessed on different levels. Van Weele (2010) presents four levels of supplier assessment:

- Product level
- Process level
- Quality assurance system level
- Company level

Gordon (2008) also describes the need for segmenting the supplier base; to decide which suppliers to measure and then, determine the level of evaluation. Some suppliers need only brief monitoring while there are others that should be more thoroughly evaluated. According to the Aberdeen group (2002), measuring only a small proportion of the supplier base can make sense; however the measuring firm is then exposed to some level of risk if they do not cover the entire supply base or at

least a larger part of it. Even unsatisfactory performance by smaller suppliers can have significant impact on the operations of the buying firm.

3.3 Performance measurements



Indicators that measure performance within or outside an organization can be configured in different ways, but should be created in order to fulfill the following criteria presented by Franceschini et al. (2007):

- Be representative
- Be easy and simple to interpret
- Be easy and quick to update
- Be sensitive to changes within or outside the own organization
- Be easy to collect and process in terms of data
- Be capable of indicating trends over time

The names indicator, measurement or metric can all be used interchangeably (Franceshini, et al., 2007) and will so be throughout this thesis. The indicators provide three basic functions for the organization; control, communication and improvement. First, the company will gain control from the evaluation and therefore controlling the performance within the organization. Secondly, the indicators are important means of communication both of the current state within the own organization as well as along the supply chain. If the indicators are poorly designed, the message communicated will instead of bringing clarity, create frustration and confusion. Last, indicators of the work situation will identify gaps between performance and the expected outcome. The size of the different gaps between the current state and targeted goal points out necessary improvements through information and feedback (Franceshini, et al., 2007).

One important aspect in order to differentiate the performances measured is to make the distinction between performance measurements measuring efficiency and effectiveness. According to Chow et al. (1994), efficiency is defined as doing things right whereas effectiveness is doing the right thing. Doing things right can also be said to equal performing the activities as well as possible and doing the right thing as selecting the right activity to carry out (Asmild, et al., 2007).

Another distinction between the two is with regards to customer satisfaction where effectiveness is to which extent customer requirements are met and efficiency measures how the economic resources are exploited when achieving a determined level of customer satisfaction (Lai, et al., 2004). The quality aspect can also be used, where efficiency monitors the output of an activity in relationship to the resources used as input and effectiveness monitors the quality of the work performed (Rasmussen, et al., 2009).

3.3.1 Key performance indicators

Within an organization there are a vast number of metrics that are being measured on an hourly, daily, weekly, monthly and/or annual basis. Some of these metrics are seen as more important and critical than others; these target measures are called Key Performance Indicators (KPI) (Franceshini, et al., 2007; Rasmussen, et al., 2009). All KPIs are metrics, although all metrics are not necessarily a

KPI since it is preferred to only have a few KPIs (Rasmussen, et al., 2009). This relationship is illustrated in figure 10.

Figure 10; Relationship between all metrics and the KPIs of an organization. Source: Rasmussen et al., 2009

A KPI measures how well the organization or department in question performs on a strategic, tactical or operational activity that is crucial for the success of the organization, either currently or in the future (Parmenter, 2009; Eckerson, 2011). A KPI is tied to a specific target measure, often a ratio in percentage of an actual figure that provides a reference point. This reference point acts as the basis for comparison over time (Franceshini, et al., 2007; Rasmussen, et al., 2009) and puts the KPI in a context where the targets and thresholds decided upon allows the performance to be valued (Eckerson, 2011). These metrics, selected as KPIs should fulfill not only the characteristics for an indicator as presented by Franceschini et al., 2007, but also several other characteristics. They should be aligned with the corporate strategy and objectives in order to drive the business values and be indicators of the performances desired by the organization (Parmenter, 2009; Eckerson, 2011). Accurately chosen KPIs are tightly and inevitably connected to strategy, and strategy without follow-up from KPIs is useless as well as the other way around (Franceshini, et al., 2007).

Other characteristics of KPIs are that they should make it possible to intervene, and provide information on when actions need to be taken and problems or trends should be acted upon (Parmenter, 2009; Rasmussen, et al., 2009; Eckerson, 2011). If the different KPIs are assigned to a specific group or individual responsible for the outcome, the attention and monitoring will most likely be more precise and actions taken before it has gone too far. Within the group, the total set of KPIs should also be balanced and reinforce each other, instead of undermining one and other favoring sub optimization. The KPIs should provide a holistic view, once again aligned with the overall strategy (Eckerson, 2011).

When the decision has been made on which KPIs to measure, it is important to determine how each KPI should be defined. The KPIs involving calculation of time should be defined according to two events. Initially there is the trigger, a specific action that represents the time for starting the time period. At the end of this time period there is a final event that stops the calculation. The result between these two events is the measurable time period which needs to be recorded in order for the data collection to be efficient. These three factors together provide the TMR; trigger, measureable time period and records, see figure 11. (Charron, 2006).

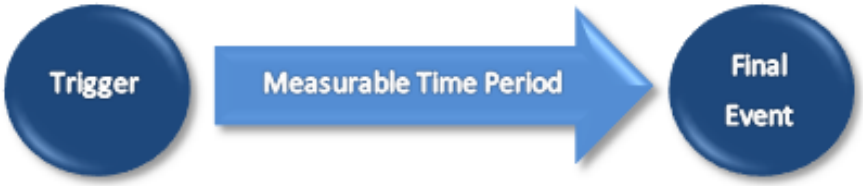


Figure 11; Schematic picture of measuring a KPI based on time.

3.3.2 Motives for performance measurements

Neely (1999) presents seven different reasons why firms should use performance measurements and why the trend has shifted from only hard financial data to more sophisticated and developed measurements.

- The changing nature of work
- Increased competition
- Specific improvement initiatives
- National and international awards
- Changing organizational roles
- Changing external demands
- Powerful information technology

One of the most prominent reasons for performance measurements in Neely's (1999) list are those of the changing climate for businesses. This includes increased competition due to globalization and new ways on allocating overhead costs in accounting. The harder competitive climate encourages companies to measure their performance in order to be able to differentiate themselves. What a company measures also indicates how they intend to deliver value to their customers (Franceshini, et al., 2007). The competition has moved from offered products and cost as an order winner, to services and non-financial factors as the competitive advantage resulting in the need to measure these and gain information. The power of the information technology is though the main enabler for the use of performance measurements. The information technology is capable of collecting and analyzing data fast and easy. It is also able to review data and take subsequent actions. (Neely, 1999).

3.3.3 Characteristics of performance measurements

When evaluating performance measurements, several aspects need to be considered in order to cover different angles. These angles may contradict each other but together they create a common and holistic viewpoint when measured (Krauth, et al., 2005). It is not sufficient to measure only one indicator of performance; hence the problem is to capture the most important performance dimensions within the evaluated context and create an own list of measurements suitable to that organization (Caplice & Sheffi, 1995; Chow, et al., 1994).

The time horizon is also important to evaluate when creating a suitable list of measurements, whether or not the measurements should be on a long-term or short-term focus. For measurements on a more strategic level, long-term measurements are more important while on an operational level with decisions made on a day-to-day basis, short-term measurements provide more value (Krauth, et al., 2005). In discussions regarding time, the importance of being able to track measurements over time is another important factor in order to follow-up and detect trends, negative as well as positive (Franceshini, et al., 2007).

In 1992, Kaplan and Norton presented the balanced scorecard, a new way of combining, or balancing performance metrics from various perspectives. The basic idea behind the balanced scorecard is to allow managers and other decision makers to not have to focus on only one specific type of measures, but to combine different perspectives into one uniform picture that provides a holistic view of the company's operations. The authors compare the idea with the cockpit of an airplane where the pilot cannot rely on only one indicator, but have to keep control over several parameters at the time (Kaplan & Norton, 1992).

In their framework, Kaplan and Norton (1992) combine financial and non-financial measures which are divided into four different categories; financial, customer, internal business and innovation and learning. While the financial measures, consisting of so called lagging indicators as described in section 3.3.3.3, are a result of the actions already taken, the remaining three perspectives consist of non-financial or operational metrics that are the drivers for future financial results (Kaplan & Norton, 1992). According to the authors, the balanced scorecard minimizes information overload due to the limited number of measures included and only the most critical metrics are focused upon (Kaplan & Norton, 1992).

3.3.3.1 Hard and soft measurements

One of the first aspects to take into consideration when characterizing measurements is that of hard and soft measurements, where the hard ones are the traditional ones and dominated by numerical factors. These are based on financial reports or operational results, such as time and cost (Chow, et al., 1994). Franceschini et al. (2007), even make a distinction between financial indicators, measuring the past performances in monetary terms, and the process indicators measuring the competitiveness in time, flexibility, quality, productivity and environmentally purposes.

The traditional hard measurements are not seen as sufficient on its own and criticized for lacking strategic focus, encouraging short-termism; where local optimization fail to provide customer information. They are also historically focused and do not provide information about what will happen next (Neely, 1999). The hard financial measurements though, create an overview if the company's execution and implementation of the overall strategy contributes to the bottom-line result (Krauth, et al., 2005). In order to overcome these stated problems, the hard measurements should be combined with soft ones. The soft ones are self-reported perceptual data and identified in their ability to help identify problems (Töyli, et al., 2008) like customer satisfaction (Neely, 1999). In his article, Neely (1999) refers to studies that show a correlation between customer satisfaction and financial performance, where an increase in customer satisfaction also means an increase in net present value of the firm in question.

Another problem to overcome is the ability to use the performance measurements for comparison when the measurements and data collection is done externally. The hard measurements alone may not be sufficient for this purpose due to different use of standards for accounting or reporting, between the investigated suppliers. The soft performance measurements may then facilitate as a bridge towards overcoming this gap (Chow, et al., 1994).

3.3.3.2 Financial and non-financial measurements

Financial measurements are the typical measurements found in quarterly and annual reports and connected through their financial background and that they are possible to measure in monetary terms. Non-financial measurements on the other hand are those that cannot be represented in

monetary terms or any currency (Dorestani, 2009). Non-financial measurements often indicate future performances while financial measurements have a historic viewpoint, presenting financial numbers on past performances (Caplice & Sheffi, 1995).

Examples of financial measurements are revenue, profit, net sales, profit margin etc. (Krauth, et al., 2005) and for purchasing in particular such measurements could be purchasing price and other costs. These measurements are more connected to the effectiveness aspect of the organization (van Veele , 2005). Non-financial measurements are instead better for measuring the efficiency of a company's performance in comparison to only financial measurements (van Veele , 2005; Dorestani, 2009). Examples of non-financial measurements are environmental factors, employee satisfaction and customer perception (Krauth, et al., 2005).

3.3.3.3 Leading and lagging measurements

Two types of metrics to distinguish between are leading and lagging performance indicators. Gordon (2008) describes leading indicators as metrics that predict, or drive future performance. The leading metrics give an indication about upcoming financial results (Kaplan & Norton, 1996). In contrast, lagging indicators measure past performance. They consist of operational metrics that measures activities that have already occurred (Gordon, 2008). The lagging indicators are often easier to measure and belong to the most commonly used indicators among companies (Gordon, 2008). Lagging indicators is used to asses already completed performances and their results and do not offer the possibility to change the performance or its result due from the KPI (Beatham, et al., 2004)

Gordon (2008) emphasizes the importance of not only considering lagging metrics, but also take into account leading indicators in order to steer focus on future results and attain a proactive supplier performance measurement approach (Gordon, 2008). The leading indicators provide guidance on how to achieve financial results (Kaplan & Norton, 1996). The leading indicators are appropriate to use in situations where preventing the occurrence of problems is the main reason for monitoring (Franceshini, et al., 2007). They also offer the opportunity for the company to make changes as a result of the measurements. The results can be used to predict future performances of the measured activity or the opportunity to change working practices (Beatham, et al., 2004).

Kaplan and Norton (1996) stress the importance to combine leading and lagging indicators, in their book denoted performance drivers and outcome measures respectively. A mix of both categories is needed in order to achieve a good set of measurements.

3.3.4 Framework for evaluating KPIs

The characteristics of KPIs presented above will be the foundation of the framework used in order to evaluate each KPI for the dashboard. The KPIs will be analyzed and categorized according to its characteristics and the findings will be presented in a table designed as table 4 below. The KPIs will be categorized as hard or soft, financial or non-financial and leading or lagging. The categorization of the KPIs with the presented framework will ensure that the KPIs used within the dashboard at VLC will have a wide range of characteristics and enclose all aspects wanted to be measured within the dashboard.

Table 4; Illustration of the framework for evaluating KPIs and measurements

KPI/Measurement	Hard	Soft	Financial	Non-financial	Leading	Lagging
Example 1	X		X			X
Example 2		X		X	X	

The stakeholder aspect will also be considered when evaluating the KPIs. Specific focus will be put on the spread of the KPIs across the VLC departments and traffic modes. The potential dashboard KPIs will also be evaluated and ranked according to their fit and fulfillment of the different criteria that were identified in the theory chapter:

- Be representative
- Be easy and simple to interpret
- Be capable of indicating trends over time
- Be sensitive to changes within or outside the own organization
- Be easy to collect and process in terms of data
- Be easy and quick to update
- Be aligned to the corporate strategy and objectives

3.3.5 Transportation KPIs

According to Coyle et al. (2009), transportation KPIs can be divided into two main categories; service quality and efficiency. Transportation service quality simply means deliver the goods at the right time, in the right condition and at the right cost (Coyle, et al., 2009). On-time delivery precision is one way to measure delivery performance (Krauth, et al., 2005) and it has been identified as one of the most important performance indicators in transportation (Birkland, 2002; Menon, et al., 1998; Gunasekaran, et al., 2004). On-time delivery is a critical requirement in lean supply chains focusing on just-in-time (JIT) operations; consistent and accurate deliveries on time enables lower inventory levels and reduce uncertainties in the supply chain (Coyle, et al., 2009). Coyle et al. (2009) define the KPI on-time delivery as the ratio of shipments delivered on time divided by the total shipments delivered by the carrier. 95 percent is a common minimum level of acceptable performance among transportation buyers and a level of 98 percent is the target to achieve (Coyle, et al., 2009).

Coyle et al. (2009) also suggest measurement of delivery consistency; to compare the average transit time, or lead time, from origin to destination with the promised transit time. Too large deviation from both average time and promised transit time suggest inadequate service quality by the carrier (Coyle, et al., 2009). Besides delivery on time with accurate lead time, damage-free delivery is also an integral part of transportation service quality and among the most important transportation performance indicators (Birkland, 2002; Gunasekaran, et al., 2004). Delivery disruptions caused by transport incidents and damaged goods disturbs a continuous flow of material that are important for lean and JIT operations (Coyle, et al., 2009). Coyle et al. (2009) denotes this claims-free delivery and describes it as the main freight protection KPI. Most organizations have a requirement level of no less than 99 percent of claims-free deliveries but one hundred percent perfection is the goal (Coyle, et al., 2009).

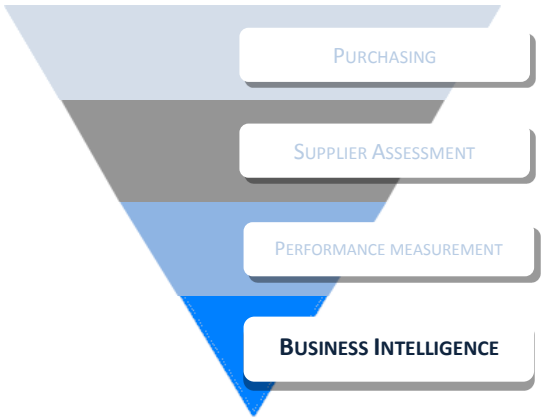
The quality of the information exchange impacts the delivery performance to a large extent (Krauth, et al., 2005). Faultless invoices (Krauth, et al., 2005) and high billing accuracy (Coyle, et al., 2009) are two performance indicators relevant in the area of information efficiency. The KPI freight bill accuracy measures the number of accurate freight bills compared to the total numbers. A common acceptable level of performance for this KPI is 95 percent and a desired target level of 100 percent (Coyle, et al., 2009). Table 5 summarizes the most important KPIs within transportation with regard to service quality.

Table 5; Summary of important service quality KPIs in transport operations

KPI
On-time delivery
Transit time accuracy
Damage free delivery
Faultless invoices/Billing Accuracy

High service quality often implies high costs. Therefore, it is not sufficient to focus only on high service levels, but it is equally important to follow-up on transportation service efficiency (Coyle, et al., 2009). There is a classic trade-off between cost and service level and companies must try to find a balance between the two parameters (Holter, et al., 2008; Coyle, et al., 2009). For many companies, transportation accounts for the major part of the total logistics cost (Coyle, et al., 2009; Gunasekaran, et al., 2004). Therefore, efficiency measures can provide an indication of what value is achieved for the money spent (Coyle, et al., 2009).

3.4 Business intelligence



Business Intelligence (BI) is an area that was first introduced in the late 1980s, but was at that time denoted Executive Information Systems. Back then, the purpose of the systems was to provide senior managers with a tool that gave better insight into the business operations (Rasmussen, et al., 2009). Howard Dresner introduced the term BI in 1989. He described it as a set of concepts and methods to improve decision making by using fact-based support systems. In later years, BI has been one of the fastest growing business software technologies in the world (Rasmussen, et al., 2009). Today, BI is referred to as a way of combining products, technology, and methods to structure key information that management requires in order to improve profit and performance (Williams & Williams, 2007). Among several concepts within the area of BI, Rasmussen et al. (2009) present dashboards, which will be described in more detail in the following section.

3.4.1 Dashboards

As the trend moves towards increased amount of information processing within companies in general, dashboards have emerged as a new tool to bring together only the most relevant data in order to enlighten the decision-making process (Rasmussen, et al., 2009). A dashboard can be described as a computer interface consisting of charts, reports, visual indicators and alert mechanisms that is compiled into an information platform (Malik, 2005). Eckerson (2011) uses the

term performance dashboard which he defines as: “a layered information delivery system that parcels out information, insights, and alerts to users on demand so they can measure, monitor, and manage business performance more effectively”.

The word dashboard derives from the automotive and the aircraft industries where the dashboard is used to monitor and maneuver a complex and interdependent system. The same intension lay behind the deployment of dashboards in the business field; to monitor and control the business operations of an enterprise (Malik, 2005; Rasmussen, et al., 2009). An illustration of a typical automotive dashboard can be seen in figure 12.

Figure 12; Illustration of an automotive dashboard. Source: (Car lovers magazine, 2010)

In a study by the Aberdeen Group (2009), the top five reasons that drive dashboard initiatives among 285 companies were identified (Aberdeen Group, 2009). These motives are illustrated in figure 13.

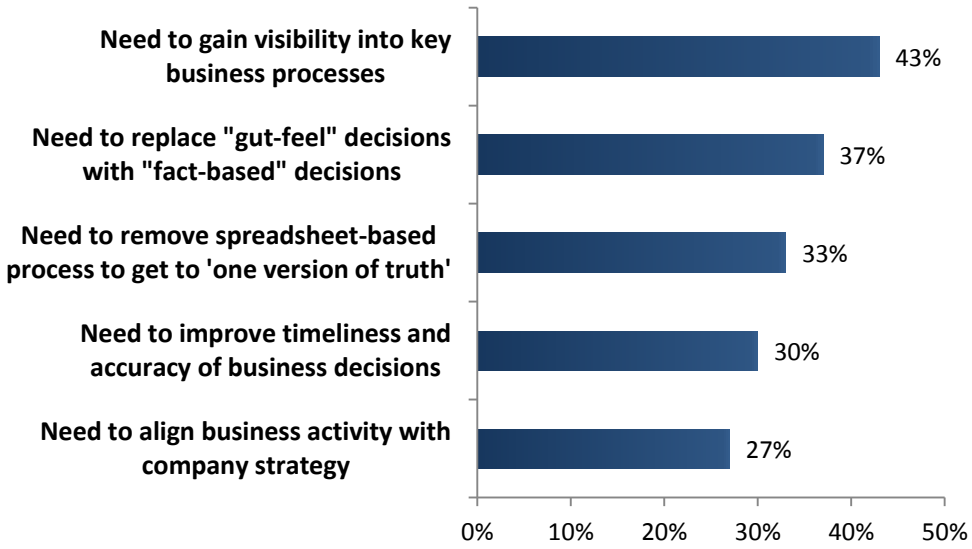


Figure 13; The top five reasons that drive dashboard initiatives, based on answers from 285 firms. Source: Aberdeen Group (2009).

Among the reasons that are presented in figure 13, most of them relates back to two main issues or needs that companies struggle with (Aberdeen Group, 2009). These include increased confidence in

decision making and secondly, to speed up access to relevant data. Confidence in decision making is enhanced when perceptions based on previous experience can be combined with, and supported by fact-based information and the decision maker do not only have to rely on a gut feeling. To enable decisions based on facts, quick access to relevant data is a prerequisite; the necessary information often arrive too late which enforces more vague decisions. However, with up to date data, more confidence can be achieved in decision making. Therefore, the pressure behind dashboard initiatives can be summarized into two main purposes; to improve quality in business information and increase the speed of access to this information (Aberdeen Group, 2009).

3.4.2 Enterprise dashboards

Similar to the automotive dashboard, the enterprise equivalent consists of a number of KPIs that are critical for successful operations; the speed- or the tachometer in the automotive dashboard can be compared to real-time indication of the most important corporate performance metrics in the organizational dashboard. An important distinction between the two, that complicates the creation of the organizational dashboard, is that each company has its unique set of KPIs.

While an automotive dashboard can be replicated into a countless number of similar copies, the creation of the organizational dashboard is much more complicated as each enterprise must identify the most important KPIs or performance indicators that are relevant for their specific operations. There is not only a difference between companies operating in the same industry, in the same market, but also between divisions within the same company. Each division has separate sets of KPIs, matching the characteristics of their operations which results in different types of dashboards depending on department goals (Malik, 2005). Figure 14 illustrates an example of an enterprise dashboard that includes typical elements such as gauges, charts and tables.

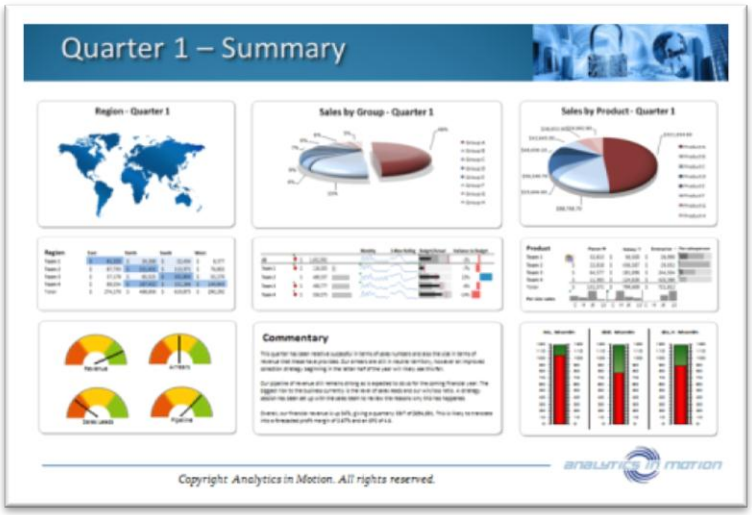


Figure 14; Illustration of an executive dashboard. Source: (Analytics in motion, 2012).

3.4.3 Characteristics of enterprise dashboards

Malik (2005) describe five basic characteristics of an enterprise dashboard that are essential for a successful outcome. These are summarized in the acronym SMART:

- *Synergetic.* A dashboard must be ergonomically and visually effective in order for the user to be able to synergize information of different nature within a single screen view.

- *Monitor KPIs.* The dashboard shall illustrate the critical KPIs that are needed for effective decision making within the domain the dashboard serves
- *Accurate.* The information that is included in the dashboard must be completely accurate in order to reach full user confidence in the dashboard. The data must be well tested and validated before included in the dashboard.
- *Responsive.* The dashboard must include functions that create user alerts like sound alarms, e-mails, blinkers etc. in order to aware the users about critical matters.
- *Timely.* The information must be real-time and right-time; it must be updated to the latest version possible in order to achieve effective decision making.

In addition to the elements of SMART, Malik (2005) emphasizes the importance to include more advanced features that cannot be found in an airplane cockpit but are essential to achieve effective organizational management. These features are captured in the acronym IMPACT:

- *Interactive.* It should provide an ability to drill down information to look at details and find root causes.
- *More data history.* The user should be able to review historical trends for the different KPIs.
- *Personalized.* The information presented in the dashboard shall match the specific domain of the user; only the data relevant for their field should be presented for more efficient usage.
- *Analytical.* The dashboard should provide the user with the ability to carry out guided analyses like what-if analysis. In addition, the user should be able to drill down, compare, contrast and analyze different business variables.
- *Collaborative.* The dashboard should enable user to exchange notes on specific observations on their dashboard.
- *Trackability.* It should enable the user to customize what metrics to track.

3.4.4 Motives for enterprise dashboards

Rasmussen et al. (2009) mention some of the benefits and pitfalls of, and motives of using dashboards presented in the two lists below. Benefits with using dashboards:

- Ability to identify and correct negative trends
- Ability to perform improved analysis through the visual presentation of performance measurements.
- Ability to align strategies and organizational goals.
- Reducing the need to create and maintain large numbers of static reports

Pitfalls with using dashboards:

- Manual data entry or lack of automated data
- Lack of useful metrics to support decision making
- Poor dashboard design

There are different types of dashboards and Rasmussen et al. (2009) distinguish between strategic, tactical and operational dashboards. According to the Aberdeen Group survey (2009), the “Best-in-Class” companies are not only deploying dashboards among executive managers at a strategic level, but are also using dashboard technology among line-level employees to support decisions of more tactical nature (Aberdeen Group, 2009).

3.5 Summary of theoretical findings

This section provides a brief summary of the most important findings of the theory chapter. This information contains the theoretical evidence that will be used to answer the research questions. The summarizing chapter is structured around the four main parts of the theory chapter; purchasing, supplier assessment, performance measurements and BI.

Purchasing

- The purchasing function has several objectives. The following list includes the objectives of purchasing that are related to supplier assessment:
  - To maintain effective relationships with existing suppliers and develop alternative sources of supply in order to ensure continuous supply.
  - To buy efficiently and wisely. With ethical means, obtain the best value for the money spent.
  - To select the best suppliers in the market.
  - To maintain a correct balance between quality and value.
  - To perform supply management in an environmentally responsible way.
- The relationship between the buyer and its suppliers can generally be illustrated in two different models; the butterfly model where there is one point of interaction between the parties, or the diamond model where there are several points of interaction between the buyer and the supplying firm.
- A large part of the characteristics related to the process of purchasing of goods also applies to the process of logistics purchasing. However, the ways in which some activities in the process are performed differ in character. Furthermore, generally within procurement of logistics services, the relationship between the buyer and the supplier is more of a business to business relationship which sometimes requires closer interaction and closer monitoring in order to make sure that the performance of the supplier does not negatively affect the service provided to the end customer.
- All suppliers of a buying firm constitute the company's supplier base. For more efficient sourcing the supplier base can be structured in different ways. One way is provided by the Krajlic-matrix which is a tool for portfolio analysis of the supplier base. The Krajlic-matrix includes four different categories of sourcing strategy; supply management, sourcing management, materials management and purchasing management.

Supplier assessment

- The connection between efficient management of the buyer-supplier relationship and competitive advantage has been addressed by several authors (Talluri & Sarkis, 2002; Sarkar & Mohapatra, 2006; Gordon, 2008). In a study by van Laarhoven et al. (2000), it was shown that in those buyer-supplier relationships where there is a strong performance orientation and performance reviews are carried out more frequently, more successful results are achieved than in those relationships where there is less focus on performance.
- In order to monitor and control that the suppliers perform according to the required levels of performance, companies use performance measurement to manage their supplier base. Gordon (2008) defines supplier performance management as "The process of evaluating, measuring, and monitoring supplier performance and suppliers' business processes and practices for the purposes of reducing costs, mitigating risk, and driving continuous improvement".

Performance measurement

- Performance indicators provide three basic functions for the organization; control, communication and improvement. It was also found that performance measurements are the most efficient method for supplier monitoring.
- Six criteria as presented by Franceschini et al., 2007:
  - Be representative
  - Be easy and simple to interpret
  - Be easy and quick to update
  - Be sensitive to changes within or outside the own organization
  - Be easy to collect and process in terms of data
  - Be capable of indicating trends over time
- Performance indicators can be categorized in different ways depending on their characteristics. Three categories were presented; financial or non-financial, hard or soft and leading or lagging.
- The most important performance indicators within transportation were identified:
  - On-time delivery
  - Transit time accuracy
  - Damage free delivery
  - Faultless invoices/Billing Accuracy

BI and enterprise dashboards

- Five reasons that drive dashboard initiatives among companies were presented; gain visibility, make fact-based decisions, obtain one version of data, improve timeliness and accuracy of decisions and align business activity with company strategy.
- An efficient dashboard should have the following characteristics; accurate, responsive, interactive, analytical, collaborative, synergetic and provide data history.
- A number of benefits of a dashboard were identified; ability to identify and correct negative trends, perform improved analysis through visual presentation and reduce number of static reports.
- A few pitfalls related to dashboard initiatives were also identified; lack of automated data or need for manual data entry, lack of useful metrics and poor dashboard design.

4 Empirical findings

In this chapter, the empirical findings needed for answering the research questions are presented. The chapter is structured according to the main focus areas that are illustrated in figure 15; the supplier base, the dashboard and the departments at VLC. As figure 15 shows, it is primarily the characteristics of the supplier base and the supplier assessment activities performed within the different VLC departments that shape the conditions for the creation of a supplier performance dashboard.

First, the requirements related to the dashboard are presented together with the areas of applications. Thereafter the structure of the supplier base is presented, followed by the measurements at each department within VLC. Finally, a summary of the discovered prerequisites and specific conditions is provided.

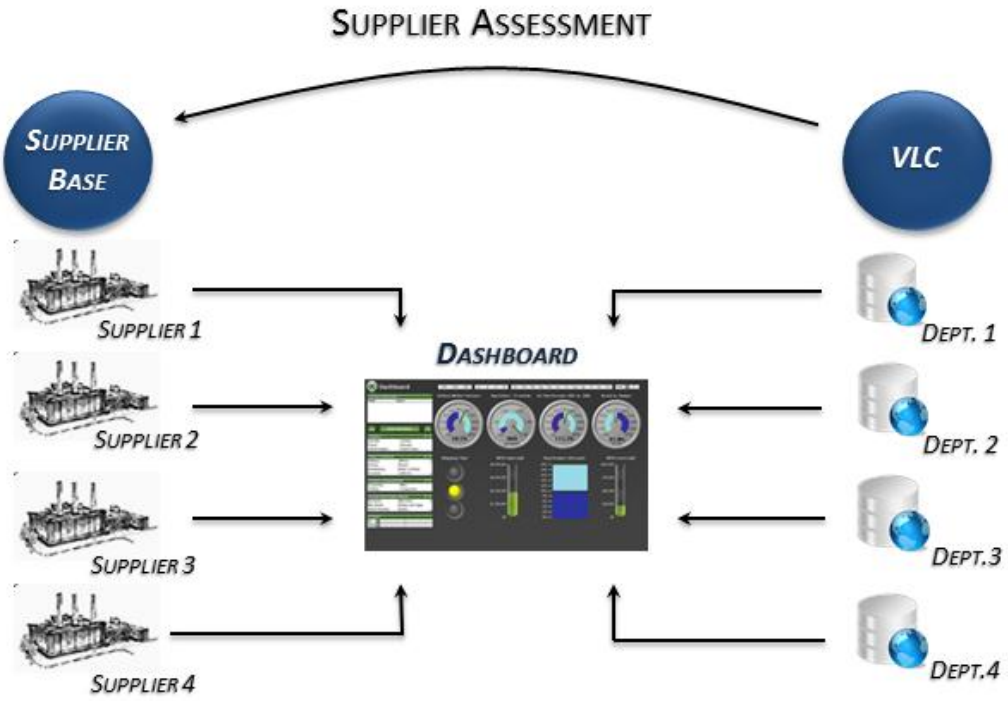


Figure 15; Illustration of the three main focus areas of the empirical chapter; supplier base, dashboard and the departments within VLC.

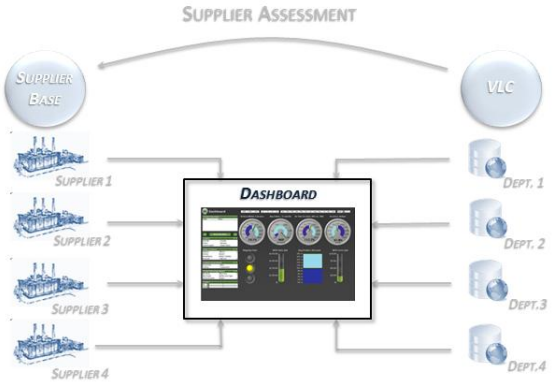
The three elements are each presented in different sections in the empirical chapter. Each section describing the different departments is further divided into three parts. Research question one is connected to the first general description of each department and their supplier evaluation process today as well as the second part of which measurements that are carried out. The current measurements from all departments will also form the basis for answering the second research question on which KPIs to include in the Supplier performance dashboard. Last, the third part on level of aggregation and system storage for the KPIs will answer the third research question.

Empirical evidence connected to the research questions are presented in several different parts of this chapter. For a summary of empirical findings and related research questions see table 6 below:

Table 6; Description of what empirical findings will be used in order to answer the different research questions

Research Question	Empirical evidence
RQ 1: How is the supplier performance evaluation process currently carried out at VLC?	- Interviews with employees within different relevant departments within the VLC organization. See appendix 1 and 2 for further details. - Review of internal documentation - Observations
RQ 2: What performance indicators should be included in the Supplier performance dashboard?	- Thorough interviews within VLC; map what is actually measured within VLC today and verify that data is accessible and consistently defined. - Relate to corporate strategy and goals -Interviews with buyers and key users/stakeholders of the dashboard to clarify basic requirements - Interviews with suppliers to gain insight in their attitude towards a Supplier performance dashboard and to investigate possible transformation of data from the supplier through self-reporting.
RQ 3a: Where is the information relevant for the Supplier performance dashboard stored?	-Interviews with employees within relevant departments of VLC to identify in what systems and what format different measurements are stored. See appendix 1 and 2 for further details.
RQ 3b: How can the information relevant for the Supplier performance dashboard be identified?	-Interviews with employees within relevant departments of VLC to identify how the performed measurements are linked to suppliers and what type and level of identification are used. See appendix 1 and 2 for further details.

4.1 The supplier performance dashboard at VLC



According to VLC, the intension behind implementation of a supplier performance dashboard is to move away from decisions based on individual perceptions towards management by facts; to make sure that actions are taken in support of pure facts and not based on vague opinions.

4.1.1 Areas of application

The main purpose of the supplier performance dashboard is to be an element of a Supplier Management Forum at VLC. The forum will be coordinated by Purchasing Strategy & Support (PS&S), but representatives from different departments within VLC will also participate. The Supplier performance dashboard is going to be a tool to follow up supplier targets and VLC desires to include Operational, Financial and Core Value related requirements. As a part of the Supplier Management Forum, the dashboard is going to support common actions to improve supplier performance and also, escalate supplier issues and decide upon suppliers to be audited. Although the Supplier Management Forum is considered to be the main area of application, it is advantageous if the dashboard can be used in other contexts as well. To be a supportive tool both in commodity strategy development and for the purchasers in their daily work are mentioned as two additional areas of application.

The daily work for the purchasers involve numerous tasks within both the pre- and post-sourcing processes as well as continuous evaluation of the supplier during the contracted timespan. During the pre-sourcing process the suppliers will be evaluated on whether or not they fulfill basic Volvo requirements, involving to buy efficiently and wisely and with ethical means. It also involves making decision to obtain the best possible value for the money spent according to these prerequisites and to choose the best supplier in the market that fits VLCs predefined requirements.

It is also the purchaser's responsibility to maintain effective relationships with existing suppliers and develop alternative sources of supply in order to ensure continuous supply during the contract time, and post-sourcing when looking for alternative sources of supply. Other decisions and areas of application where the dashboard can be helpful are when maintaining a correct balance between quality and value of the supplier's offers and to perform supply management in an environmentally responsible way.

Besides these areas of application the Supplier performance dashboard should be able to fulfill the following requirements:

- The dashboard shall provide an overall view of each core supplier on supplier group level i.e. one screen image of the performance levels within the central KPIs that represent the most important requirements VLC puts on its core suppliers.
- It should be possible to view the supplier's performance within a specific business area; Inbound, Outbound and Emballage.
- It should be possible to track trend over time to identify improved or worsened performance.

- It should be possible to drill down and aggregate up the data to supplier group level, PARMA-ID, contract and flow level in order to view the supplier's level of performance within different regions and specific flows.

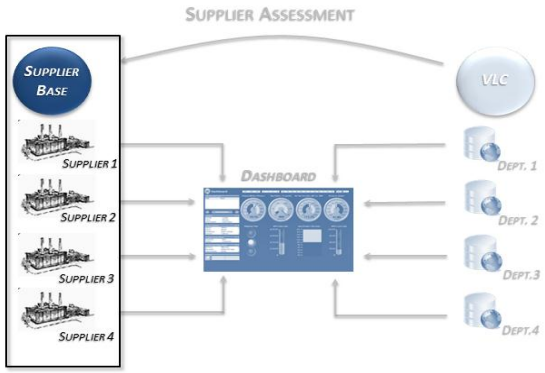
4.1.2 Purchasers view on measurements for the dashboard

The purchasers within the Global Purchasing department, located at the Gothenburg office, was asked to rank the most important measurements for supplier evaluation within their mode of transport, for interview guide see appendix 4. The summarized answers can also be found in appendix 4, and presented below are a list of the eight most important measurements:

- Price/Cost
- Lead-time/Precision
- Financial ranking
- Damage free delivery
- Quality
- ISO 14001/9001/SmartWay
- Corporate Social Responsibility (CSR)
- Future potential

These measurements are important to include in the Supplier performance dashboard and needs to be compared to the measurements performed within the different departments at VLC presented later in this chapter. This needs to be done in order to align the recommended measurements with the view of the purchasers.

4.2 The supplier base



The supplier base of VLC consists of 887 suppliers where 154 of them, or 17 percent, are considered to be core suppliers. The core suppliers account for 90 percent of the total spend (Global spend report 2011). Figure 16 illustrates the division of total spend among the three business areas within purchasing; Inbound, Outbound and Emballage. Inbound accounts for the largest share with 52 percent of the total spend while Outbound has a total of 38 percent and Emballage stands for 10 percent.

Among the 154 core suppliers, there are 88 that are active within only one of the three business areas. This means that 66 suppliers, or 43 percent of the core suppliers, are active in more than one business area. In figure 17, the total number of active core suppliers per business area is displayed; 101 core suppliers within Inbound, 93 within Outbound and 57 within Emballage. Several suppliers are active in dual business areas and 27 core suppliers are active within all three business areas.

Concerning the four traffic modes; air, rail, road and sea transportations, a division per total spend is illustrated in figure 18. The largest traffic mode is road with 67 percent of the turnover followed by sea with 23 percent. Rail is the smallest traffic mode with only 4 percent of the turnover and rail accounts for 6 percent. All numbers are calculated on the turnover per 2011 for the entire supplier base.

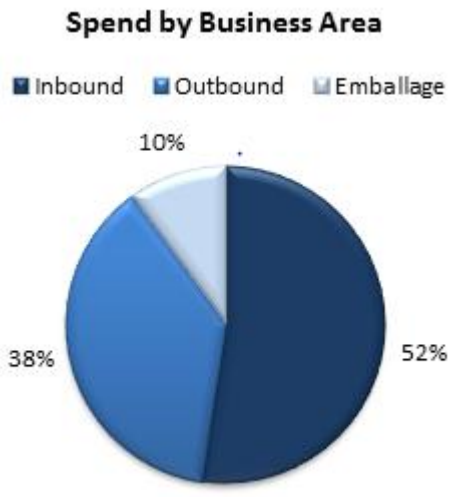


Figure 16; Spend divided by business area, 2011.

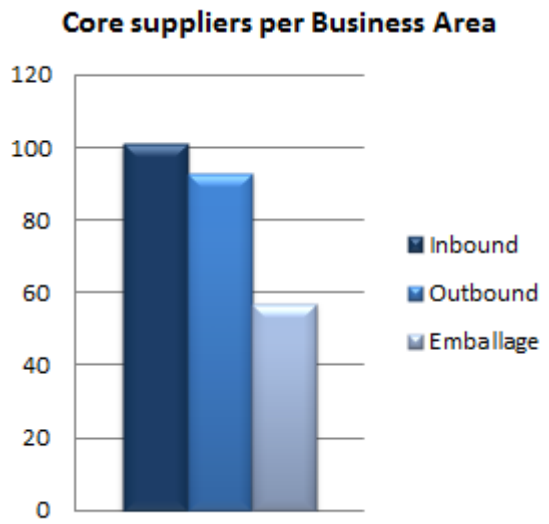


Figure 17; Number of active core suppliers per business area, 2011

Figure 18; Spend divided by traffic mode, 2011.

4.2.1 Supplier performance requirements

To achieve consistency in supplier agreements, VLC has developed generic contracts that are specifically adjusted to the different commodities that are explained in more detail in chapter 4.2.2. In the contracts, the required performance levels for different parameters and KPIs are formulated for each specific contract. Since the performance requirements vary depending on location, VLC has also developed generic contracts that adapts to the region of the world where the operations are carried out.

Attached to each contract is a standard operating procedure (SOP)-document that specifies the requirements on operational procedures. The SOPs are developed by the Global Business Operations (GBOs) according to the demands of the customer. More details about the performance requirements set by the GBOs are provided in chapter 4.4.

4.2.2 Sourcing strategy

The operations at the purchasing department of VLC are divided into 21 different commodities spread over the three business areas Inbound, Outbound and Emballage see table 7. The table provides a rough description of what logistics related services and materials are being bought by the purchasing department of VLC.

Table 7; Overview of the different commodities that are applied by the purchasing department.

INBOUND	OUTBOUND	EMBALLAGE
Road – FTL	Road – Cars	Logistics Services – IB related
Road – LTL	Road – Truck & Buses	Logistics Services – OB related
Road - Express	Road – High &Heavy	Logistics Services – EMB related
Rail	Road – Passenger	Packaging Material Plastic
DeepSea & ShortSea - Container	DeepSea - RoRo	Packaging Material Wood
Air – Forwarders		Packaging Material Disposable
Air – Integrators		Packaging Material Metal
Air – Charter		
LCL forwarder global		

Transportation services accounts for the major part of the purchases, while logistics services and packaging material as well as non-automotive products (NAP) accounts for a smaller share of the total spend, see figure 19.

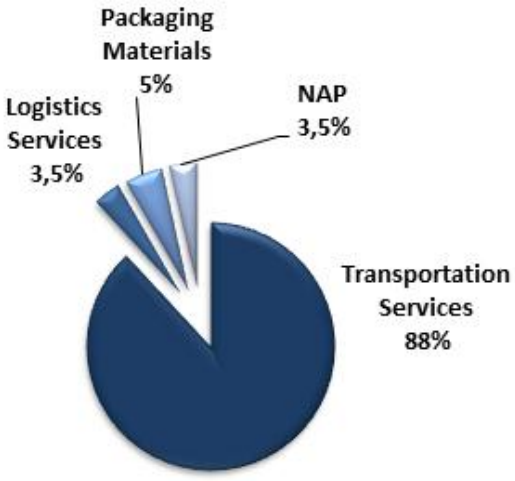


Figure 19; Pie chart visualizing the spread of purchased goods, 2011

Currently, the purchasing department is developing specific strategies for each of the commodities that are included in table 7. One potential area of application for the supplier performance dashboard is to be a supportive tool in the commodity strategy development work. The aim of the

strategy development work is to find the right sourcing strategy for each of the 21 commodities and provide the purchasers with guidelines towards which suppliers to sign contracts with.

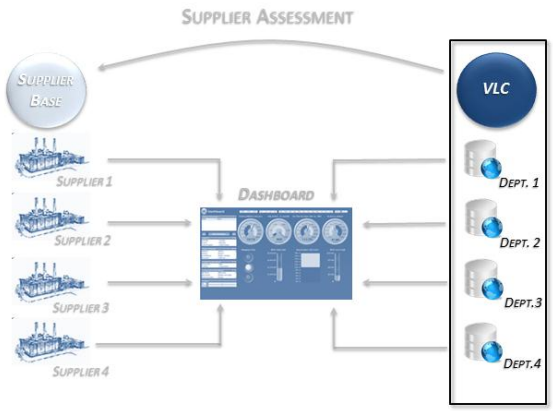
For each commodity the potential suppliers will be grouped into four different categories according to their importance, and within each category the suppliers will be prioritized. This prioritization will depend on the supplier's performance and its importance to the operations of VLC. Within the first category a number of two to ten suppliers will be ranked as strategic suppliers. These strategic suppliers should be considered first when a new tender within the specific commodity are to be negotiated. Within the second category suppliers should be used if the ones categorized as strategic in the first category for some reason cannot be used. In the third and fourth category suppliers that have potential or are required by customers are grouped. If a supplier from one of these categories should be considered for a contract, the issue must be approved by the purchasing director. Signing contracts with suppliers from the first two categories can be done on the purchasers own mandate since it is aligned with the commodity strategy.

4.2.3 Supplier self-reporting

Today, the suppliers provide VLC with information about their own operations and current status regarding environmental, quality and safety work. The annual supplier survey and regular Requests for Information (RFI) is one way to collect supplier self-reported data and the carriers are also carrying out daily reporting into the different operational systems regarding pick-up and delivery confirmation. However, it is interesting to investigate the suppliers' thoughts and ideas about extended reporting; the suppliers willingness to share with VLC their own measurements and performance levels e.g. through self-reporting.

A list of questions was sent out to five of the top suppliers of VLC, spread on the different traffic modes sea, rail and road transports. The list of questions is included in appendix 3. It was shown that the suppliers were positive towards a Supplier performance dashboard and they see the dashboard as a tool for communication and a way to build a closer relationship between themselves and VLC. One of the initial ideas regarding self-reporting by the suppliers into the dashboard considered measurements on emissions. However, it was found that the suppliers did not carry out more detailed or frequent measurements than the ones available through the fleet sheets within the Supplier Survey. Neither were operational measurements on lead-time and precision performed in a way that would allow the suppliers to report these metrics into the dashboard.

4.3 Supplier measurements within VLC



Within VLC, there are several departments that carry out supplier measurements, supplier assessments and varying levels of supplier follow-ups. In this section, the different departments of relevance regarding data collection to a supplier performance dashboard are presented. First, the measurements collected and stored at the Global purchasing department is presented whereby a description of measurements and storage systems connected to the GBOs, Operations excellence, Risk Management and Invoicing & Cost Control

departments follow respectively.

Each department will be presented in the same way, starting with a general description of the departments objectives. The second part is covering the measurements currently performed within the specific department and third the systems in which the measurements are collected and the level of aggregation upon which they are measured will be described. The IT projects of LES and ATLAS will have a large impact on the supplier performance dashboard, for background information see appendix 6.

This division is in close connection to the three reasearch questions of this thesis, see table 8. Research question one is connected to the first general description of each department and their supplier evaluation process today as well as the second part of which measurements that are carried out. The current measurements from all departments will also form the basis for answering the second research question on which KPIs and measurements to include in the Supplier performance dashboard. Last, the third part on level of aggregation and system storage for the KPIs and measurements will answer the third research question.

Table 8; Structure of chapter 4.3 and alignment with research questions

Research question	Content
RQ 1	General description
RQ 2	Measurements
RQ 3a, 3b	Systems & Identification

4.3.1 Global Purchasing

The Global Purchasing function of VLC is responsible for purchasing of transport, logistics services and packaging material. Global Purchasing serves both internal AB Volvo customers and external customers. The function is organized around the three business areas Inbound, Outbound and Emballage as previously mentioned. The purchasing department Inbound is responsible for procurement of transports of material and emballage in to the factories while the Outbound department buys the transports of finished products that is going to be distributed to the dealers. Emballage purchases packaging material and services related to logistics centers and terminals.

4.3.1.1 Measurements

Within the Global Purchasing function of VLC, the department PS&S has some specific areas of responsibility regarding measurements of, and follow up on supplier performance. In the sections below, these areas are briefly described starting with presentation of RFI and Supplier Survey, then followed by a description of the financial analysis of suppliers and ended with presentation of the global spend report.

RFI and Supplier Survey

Within the Global Purchasing function of VLC, the department PS&S is responsible of carrying out an annual supplier survey where the data is used to follow up the Core Value objectives, check compliance with the supplier requirements and to perform environmental calculations. The results are also used in communication with the stakeholders of VLC. Participation in the survey by all suppliers has been mandatory since 2009. The survey is carried out in the beginning of each year and sent to the suppliers on a group level. More information regarding the measurements and KPIs that are the results of the supplier survey are included in chapter 4.5; Operational excellence. The metrics

are summarized in chapter 4.5 since the core value related metrics should be presented together. Even if the PS&S department is carrying out the process of the supplier survey and Operational Excellence only is a supportive function, the metrics will be presented there.

PS&S is also carrying out Requests For Information (RFI) approximately every other year where similar questions as in the supplier survey are being asked to core suppliers. However, in the RFI, there are additional, more detailed questions included. The intension by VLC is to merge the supplier survey and the RFI in order to be more efficient and only send out one survey.

Financial analysis of VLC' suppliers

Within the department of PS&S, the financial status of VLC's major suppliers is monitored and analyzed. The monitoring is essential in the economic downturn since some suppliers are likely to be, or will end up in a situation with a high risk for business failure requiring actions from VLC. The information is delivered by two financial institutes, one covering Scandinavia and one covering the global suppliers. The financial information about the suppliers in the European countries is continuously updated as soon as changes occur, while the remaining suppliers are updated annually. All core suppliers are being monitored in the financial analysis.

The financial analysis provides different components; credit worthiness, financial data/ratios and the supplier's ability to pay. The analysis is summarized in a ranking, a risk indicator from 1-4, representing the total risk for business failure of the supplier. The four levels of ranking are denoted as follows:

1= Low risk
2= Lower than average
3= Medium
4= High risk of business failure

If a supplier is ranked with a level of 3 or 4, it is the responsibility of the accountable purchaser to contact the supplier and take actions. Such action could be to monitor the supplier closely, that the owner company of the supplier takes financial responsibility for the supplier if being a part of a larger organization or making sure that the supplier has launched measures for cost-savings and other rationalizations for VLC to monitor. Depending on the status of the supplier within the VLC supplier base, the actions may differ. A smaller supplier within express transportations is not as crucial and can for instance be replaced much easier than if a supplier with a large spend and is hard to replace is facing financial troubles.

Global spend report

In addition to the financial analysis and ranking of the core suppliers, a Global spend report is carried out twice a year by the PS&S department. Information about amounts spent on each supplier is collected manually from local sites and compiled. The data is originally collected from the supplier's invoices and therefore, the information is on PARMA-level. Since all sites do not share the same systems support, the data cannot be attained automatically but requires manual reporting. This restricts the possibility of more frequent updates of the spend data than semi-annually.

4.3.1.2 Systems and identification

Supplier Survey

The results from the Supplier Survey is gathered and stored in excel-files, maintained by the PS&S and Operational Excellence departments. Operational Excellence performs calculations on fleet sheets and other environmentally connected measurements while PS&S are maintaining the ISO related excel-files. More information regarding the measurements and KPIs that are the results of the supplier survey are included in chapter 4.5 Operations excellence.

Financial analysis of VLC's suppliers

The information and ranking gathered through the external financial institutes are summarized and stored in an excel-file, updated and controlled by a member of the PS&S department. The information is sent by mail to the responsible employee from the suppliers and the reports are also stored as PDF-files.

The financial evaluation is performed on supplier group level as extensively as possible. A large supplier may have many different subsidiaries connected to the parent company but it is not feasible to collect financial information on all of them. If there is a financial problem for one of the subsidiaries, it is the parent company that has the overall responsibility for the financial performance. The identification is the company identification number and PARMA-ID is not used.

Global spend report

The Global spend report carried out by the PS&S department is compiled within an excel sheet, where the information can be divided and displayed in different ways. The excel sheet displays a complete picture of what has been spent globally and it is possible to derive the amounts of each supplier to either inbound, outbound or emballage operations. The data is presented on PARMA-level but it is also possible to aggregate it to the total spend on a supplier group level. There is also a representation of the spend data in each of the regions North Americas (NAM), Europe, Middle East & Africa (EMEA) and Asia & Pacific (APAC).

For the European region, it is possible to extract data on a more frequent basis since the information is stored in a data warehouse. The information is gathered from the Invoicing & Cost Control (I&CC) department, dealing with all invoices at VLC. However, as this system is not used globally at all sites, monthly updates would create data disparity and it would not be possible to get a complete picture of the total spend globally. The supplier measurements within purchasing are summarized in table 9.

Table 9; Summary of Purchasing KPIs

Possible KPI:s	System (present)	System (future)	Identification	Global/Regional
Financial ranking	External	External	Supplier group level	Regional, Europe
Spend	Excel	LES?	PARMA-ID	Global

4.4 Global Business Operations

Within VLC, there are three Global Business Operations (GBOs); Inbound, Outbound and Emballage. The GBOs are the interface between VLC and its customers. The three operations are the creators of the SOPs that are attached to the business contracts. The SOPs state the requirements on what is to be purchased by the purchasing department and the supplier requirement levels are set by the

GBOs. Purchasing signs the contracts while it is the responsibility of the GBOs to ensure that the requirements are met. In the following sections, each of the GBOs is presented.

4.4.1 Inbound

Inbound is responsible for arranging movements of material, information and inventory from suppliers around the world to production facilities (AB Volvo, 2011). Inbound focuses on total logistics solutions which encompass the whole process from logistics development and design of material flow, to carrier selection, traffic control, risk management and logistics centers (AB Volvo, 2007a).

Within the Inbound operations, several cross docks are used to consolidate and repack goods that come from a number of different material suppliers and are going to be distributed to customers' production facilities all over the world. In order to improve the ability to consolidate goods, the department uses fixed, predefined pick-up days and do also, works with fixed lead times. To make this as efficient as possible, VLC determines the pick-up days while the customers decide upon the frequency of pick-ups per week. The traffic department strives to develop standard procedures that are applied globally.

4.4.1.1 Measurements

The fixed settings of lead times and pickup days also form the basis for what supplier performance metrics are most important to measure and focus upon. The most important measurements at Inbound are:

- Pick-up precision
- Delivery precision
- Lead time (transport precision)
- Deviation reporting

The measurements are illustrated in figure 20. Pick-up precision measures whether the goods has been picked up the correct day and within the right time window. Delivery precision is a measurement of the number of deliveries on time to the cross docks or the customers' goods receptions compared to the total number of deliveries. This is measured on trailer level; the number of trailers delivered on time. Delivery precision is measured at the breakpoints that are managed by VLC and at some of the customer sites where there is an agreement that the measurements should be carried out.

Inbound uses transport precision as a measurement for lead time performance; that the carriers operate according to the predefined lead times. If a transport route consists of different modes of transportation, it is divided into shorter legs where the legs are measured separately. In this case, the consignment is measured on container level. Due to system limitations, Inbound only measures lead time and pick-up precision for a part of the operations.

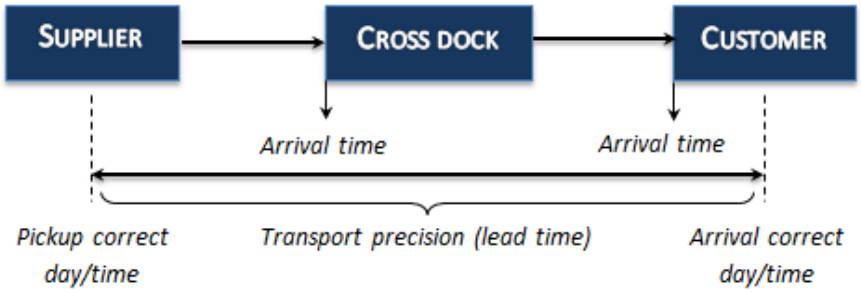


Figure 20; Illustration of the precision measurements at Inbound.

The carriers are obliged to report delays and deviations to the customer service function. Inbound has put a requirement on the carriers to have one hundred percent deviation reporting. It is an important KPI as proactive deviation reporting enables VLC to rebook transports and ensure that material and goods are delivered in time. Deviation is registered on the carrier's PARMA-ID. Most often, it is possible to decide which party is responsible for a delay; the carrier or the material supplier, but there are occasions where it is difficult to determine and disputes occur.

When the transport suppliers do not perform according to the requirements, Inbound has developed an escalation ladder. There are several units on the operational level that have direct contact with the suppliers and the intension is that the most urgent issues are managed and solved by those units. If the issues cannot be solved, the case is escalated to a person responsible for traffic. The second level of escalation is when the responsible purchaser becomes involved and if the problem persists, the purchasing manager intervenes.

4.4.1.2 Systems and identification

The ability to measure carrier performance at Inbound varies depending on location and what system is employed. There are mainly three systems in use; Transport Information Routines (TIR), Forwarding Administration System (FADS) and Advanced Transport Logistics for Automotive Supply (ATLAS). If comparing the measurement systems, they do not measure all the same KPIs and different definitions for measurements apply. TIR and FADS will eventually be replaced by ATLAS and in the future ATLAS system, the same KPIs and definitions will be used and the same working procedures concerning these issues can be applied. ATLAS is also the main system for the operations in the US but the system is still under development. The intension is to have a global system that enables consistency in the measurements regardless of location around the world, which is hard to achieve with separate systems. Some of the new functionalities in ATLAS will be introduced in mid-May, beginning of June in 2012, but additional functionalities will not be implemented until the end of year 2012. The first roll-out will cover the European road operations and additional areas will be added in later stages.

In order to identify underperforming carriers, Inbound has recently started to compile carrier performance in an excel sheet since data cannot be found in only one system. The transport suppliers that account for the largest share of the turnover are assessed. Traffic managers globally are responsible of reporting, on a monthly basis, the status of the performance of the carriers within the most important KPIs. The measurements are registered on contract level since Inbound wants to assess how different transport suppliers perform in different regions; one supplier that accomplishes

a certain level of performance in one region may not reach the same levels in another part of the world.

The KPIs are divided into three groups that each receives an overall score; precision, system availability and proactiveness. Precision includes pickup precision, lead time precision and delivery precision. System availability measures ATLAS input and FADS input while deviation reporting and availability connect to proactiveness. The excel sheet does not contain information about actual supplier performance levels but color coded numbers from 1-4 represents the supplier's status in the escalation process. If a supplier has reached level four, it means that the issue has formally been handed over to the purchasing department. One of the purposes with the excel sheet is to be more clear towards purchasing; to make clear that when a case is handed over, Inbound has already handled the issue in several steps and it is the responsibility of the purchasers to take further action towards the supplier.

The executive team of Inbound has recently initiated a forum where representatives for the Inbound departments Traffic and Logistics development, and Purchasing meet regularly. The primary topic for these meetings is deviations; where different types of deviations that are compiled in a weekly report are being discussed. Inbound distinguishes between three types of deviations; internal reported, carrier reported or customer reported deviations, where the last mentioned is the most severe one. Carrier reported deviation in itself is undesired, but still, it enables Inbound to alert the customer about the delay and it is possible to rearrange the transport or book rushes.

Inbound also employs carrier evaluations. Depending on the strategic importance of the transport supplier, meetings are held between Inbound representatives and transport suppliers one to two, or four to six times a year. The Inbound related supplier KPIs are illustrated in table 10.

Table 10; Summary of Inbound KPIs

Possible KPI:s	System (present)	System (future)	Identification	Global/Regional
Delivery Precision	TIR/FADS/ATLAS	ATLAS	Lane-level	Regional, Europe
Pick-up Precision	TIR/FADS/ATLAS	ATLAS	Lane-level	Regional, Europe
Lead time	TIR/FADS/ATLAS	ATLAS	Lane-level	Regional, Europe
Deviation Reporting	TIR/FADS/ATLAS	ATLAS	Lane-level	Regional, Europe

4.4.2 Outbound

The Outbound GBO of VLC is responsible for delivering finished products from factory to customer. Outbound operates globally and offers transportation of various types of vehicles as well as related complete distribution solutions for logistics and information services. Within the service scope of Outbound several areas is found; both distribution of vehicles from consignor to consignee of as well as local vehicle movement within factory yards. Exhibition and introduction material, special and secrecy transportations, local courier pick-up of cargo as well as personnel transportations in and around Gothenburg is included in the services performed by the Outbound department.

4.4.2.1 Measurements

At Outbound, the most important measurement is precision. Precision metrics at Outbound includes the KPIs delivery precision and transportation lead time. When measuring delivery precision, Outbound focuses on target fulfillment. Target fulfillment is the ratio between the actual

performance level divided by the required level of performance. If the required level of performance is 95 percent and the actual level is 93 percent, then the delivery target fulfillment value is 93/95 = 98 percent. A supplier with performance above the required level will, in principle, also achieve a lower level of target fulfillment performance. This is important to keep in mind since a higher level of performance than agreed upon, may imply higher transportation costs. Target fulfillment is also a useful measurement when assessing the performance of a supplier that operates in different regions where the performance requirements varies. With a target fulfillment ratio, it is possible to aggregate up a total level of performance for a specific supplier. Another aspect of importance is reporting; Outbound measures the suppliers' arrival and departure reporting and requires timely reporting by the suppliers.

When suppliers are not performing according to a sufficient level of performance, Outbound has a specific process to handle this. The first step contains a so called SFUR (Special Follow Up Routine) where corrective actions are taken by the operation together with the supplier. If the problem is not solved, the case is escalated to a critical supplier forum where purchasing representatives participate. The last step in the escalation process is the purchasing board which will be involved if the problem remains.

4.4.2.2 Systems and identification

The information is stored on PARMA-IDs in a global computer system called A4D (Application for Distribution). The system allows data search and presentation of data on supplier, destination, region etc. i.e. representation of data in many different ways. The Outbound related supplier measurements are illustrated in table 11.

Table 11; Summary of Outbound KPIs

Possible KPI:s	System (present)	System (future)	Identification	Global/Regional
Delivery target fulfillment	A4D	A4D	Lane-level	Global
Arrival reporting	A4D	A4D	Lane-level	Global
Departure reporting	A4D	A4D	Lane-level	Global
Lead-time	A4D	A4D	Lane-level	Global

4.4.3 Emballage and Logistics Services

The Emballage function supports the Volvo group with packaging materials; the function provides both standard and special packaging. The main responsibility of Emballage is to ensure availability of packaging material when needed. The ability to secure availability of packaging material is dependent on mainly three parameters; enough terminal space to handle the volumes, enough washing capacity to clean the used material for reuse and finally, sufficient reparation capacity to repair broken packaging. Emballage is the department in charge of estimating and detecting when capacity is insufficient, when packaging is running out and purchase of new material is needed. The new demand is then reported to the purchasing department and it is their responsibility to make the commercial negotiations.

The function works with a global pool of packaging, see figure 21, where new material is bought in centrally from the office in Gothenburg. The emballage pool is organized around approximately 40 terminals and depots that are spread into different parts of the world. Three of the terminals are

owned by Volvo; one in Gothenburg, one in Skövde and one in Poland and the rest are owned by external parties whose services are bought in regionally by VLC.

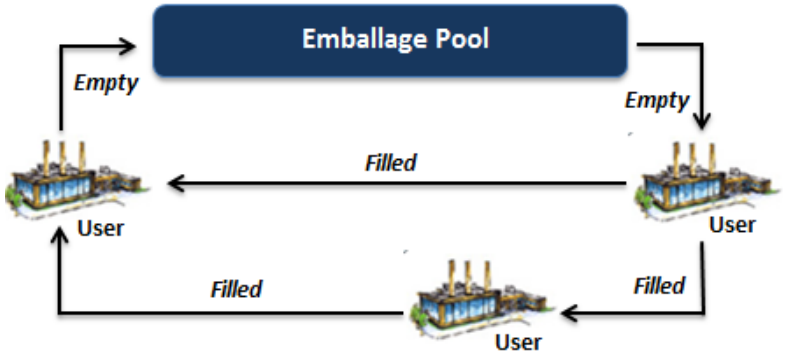


Figure 21; Illustration of the Emballage global pool of packaging

4.4.3.1 Measurements

VLC puts specific capacity requirements on the terminal suppliers but the ability to measure, and keep track of the performance of the suppliers is limited. Many of the limitations are due to system restrictions. Delivery precision is central to the operations at Emballage but currently, no system supports this or provides any ability to measure it. This problem also concerns the logistics services; Emballage wishes to put metrics on the performance of the service providers but currently, the department has no system support to evaluate and follow up on this.

4.4.3.2 Systems and Identification

Emballage works in an old, mainframe based computer system called Volvo Emballage Management System (V-EMS) where suppliers are identified with a so called Emballage-IP number and PARMA-ID is not used, even if there is a connection between the two. In V-EMS, data is only stored 18 months back in time and the system does not have any function for materials sourcing which makes it difficult to monitor supplier performance. Currently, Emballage is also using EBD (Enterprise Buyer Desktop), a system where call-offs on packaging material are made. However, this system does also have its limitations; for instance, it is not possible to feed the system with lead times which restricts the ability to work with deviation reporting. Emballage is included in the ongoing LES (Logistics Enterprise Solution)-project and the intension is that the department will get a new SAP based system where the opportunities for measurements and follow up will be better than in the current systems in use. An import KPI that will be possible to monitor in the future when LES is implemented is the Delivery Precison of new packaging material. This will enable more sufficient planning and monitoring within the department.

There are two major reasons why the department needs a new system; the V-EMS system lacks a function for planning and the balance accuracy is deficient. The planning is today, carried out with support of an enormous excel sheet but the prospects for the future is to have a system that supports both planning and monitoring of account balance. LES is mentioned as one possible solution but the project is not fully developed yet. There are however possibilities within the new system to measure delivery precision on new orders of emballage on a supplier level. The Emballage related KPI is included in table 12.

Table 12; Summary of Emballage KPIs

Possible KPI:s	System (present)	System (future)	Identification	Global/Regional
Delivery precision	N/A	LES	Supplier-level	Global

4.4.4 Emballage transportations

The transportation and movement of packaging material and emballage within VLC is monitored and carried out by the Order and Distribution Department within the GBO Emballage. This department works within five main areas; distribution of empty packaging, order handling both adjustment of orders and additional requests, deviations in delivery of empty packaging and collection of damaged packaging.

There is a strong connection between the transportation of emballage and inbound materials since they are all separate legs within a larger flow and shares the same contract with the suppliers. However, they are both under the responsibility of the Inbound department of VLC Purchasing. The supplier that carries out the transportation of empty emballage from VLC's terminals to the user is the same supplier that performs the transportation of filled emballage from the user to the VLC's customer. The user of emballage is the same as the component suppliers to the customers, and the customers are the manufacturing plants of Volvo and other external customers, see figure 22.

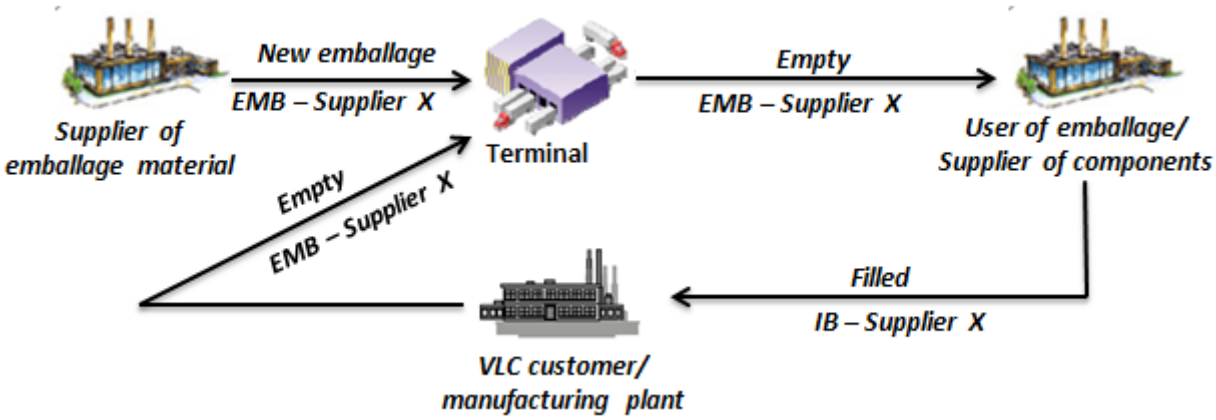


Figure 22; Flow of emballage.

The terminals are located in close proximity to the users. In Gothenburg the terminal is located in Arendal and the largest users are Volvo Trucks in Tuve and Volvo Cars in Torslanda. There are thousands of different emballage types; the most commonly used are though the L-pallet with collar and lid, as well as the blue boxes. These emballage types stand for 75 to 80 percent of the total volume.

4.4.4.1 Measurements

At the moment, it is only one measurement that is performed and that is pick-up precision. This measurement is performed on a monthly basis within Europe. Other regions outside Europe do not have the same structure and thus not the same possibilities for performance measurement due to foremost outsourcing of emballage transportation. The booking process starts with a proposal from VLC stating the total number of orders for the next week, divided on each day and specific times. The

supplier makes adjustments suitable to their schedule and an exact plan is decided upon and registered in V-EMS. It is against this plan measurements are performed.

This metric does not only measure the performance of the suppliers but also the internal performance and the performance of the terminal. It is also not only the number of orders picked-up that is measured, the reason for why a certain order is not picked-up is also logged, according to different codes.

- Other goods on the trailer.
- Too small trailer.
- Not approved trailer.
- Not collected.

All codes are measured on three levels; number of orders, volume and monetary. Between the different actors it is the internal errors that cause the largest monetary impact but it is the suppliers that have the highest number of deviations that creates the largest problem to sort out. The terminals have a lower number which is to be expected, it is though needed to point out that the coding is done by the personnel at the terminal and therefore the coding may be subjected to bias. Depending on the level used it is the ratio of the total number of orders compared to registered deviations that is the interesting information to use.

All suppliers are measured and have a requirement to fulfill 98 percent of their pick-up precision according to the contracts. However, action plans and follow-up is not done until the suppliers fall below 95 percent fulfillment. Problems are not brought to the purchasing department's attention until it turns out to be too large for the operation to deal with.

Performance measurements beyond the pick-up precision, such as delivery precision is not possible to measure today due to the fact that there is no active receiving of the goods. There is no logging of the emballage upon arrival and hence accurate measurements cannot be done. It is the users who alert the operation about problems such as goods not arriving; hence the department works reactive instead of proactive.

4.4.4.2 Systems and identification

The suppliers carrying out the transportations are identified through their PARMA-ID and for suppliers of emballage a second number for identification, EMBALLAGE-IP, is introduced. This emballage specific identification is connected with PARMA-ID, being used throughout the entire Volvo organization. For the large transportation suppliers it is however PARMA-ID that is the identification to use. Table 13 includes the Emballage transportation related supplier KPI.

Table 13; Summary of Emballage transportation KPIs

Possible KPI:s	System (present)	System (future)	Identification	Global/Regional
Unloading precision	V-EMS	LES	PARMA-ID	Regional, Europe

4.5 Operational Excellence

The Operations Excellence function at VLC works with questions related to the core values of AB Volvo and VLC as well as acting as a supportive function to all other departments. The Operations

Excellence function has governance of all core value related questions and sets up overall goals and strategies for the entire VLC organization. Each department breaks down these overall strategies into department specific core value strategies.

The core values of AB Volvo and VLC are quality, environment care and safety; values that are all central in the company's business operations. With high quality, VLC intends to get "the right product, to the right customer, in the right quantity, in the right condition, at the right place, at the right time and at the right cost" (AB Volvo, 2007). Regarding safety issues in the logistics context, VLC emphasizes the importance of appropriate speed, use of seat belts, driving and resting times, securing of loads, alcohol and drugs policies and carefully monitoring of dangerous goods.

4.5.1 Measurements

Related to each core value of AB Volvo, there are different criteria that are being demanded from the VLC suppliers. In the sections below, a summary of the performed measurements related to each core value are presented. As mentioned in chapter 4.3.1 this survey is performed by the PS&S department but the related metrics and measurements are presented below:

Quality

One demand is that the suppliers are certified according to the ISO 9001, which is a certificate for an approved quality management system. If, for some reason, the supplier cannot provide a certificate, the Operations Excellence function will have to investigate the supplier in question in order to document what other system is in use. If the investigation finds that an equivalent system to the ISO certification is used, a formal deviation handling from AB Volvo needs to be signed. This deviation reporting states that AB Volvo approves the inclusion of the supplier within the supplier base despite the lack of ISO certification. Quality issues related to damage goods are handled by the Risk Management department, which is described in section 4.6.

A supplier measurement that involves all three core values, not only quality, is the Corporate Social Responsibility (CSR) Compliance. CSR includes a number of topics related to a company's influence on its society on economic, social and environmental aspects. The suppliers are asked in RFIs and the Supplier Survey on their CSR Compliance as well as other related issues such as their approval to follow The Volvo Group's Code of Conduct. There is no consistent definition or industry standard of CSR compliancy but a new standard for CSR related questions with a third party certification is under development.

Environmental care

Within environmental care, certification according to ISO 14001 or SmartWay in the USA is required by the suppliers. Emissions from the transports are another vital part to monitor. Today, the Operation Excellence function creates stencil calculations on the emissions from each supplier from the information registered in the annual supplier survey by the suppliers. These calculations deliver an average number on emissions of CO_2 in gram per ton-kilometer per supplier. The calculations are created from the fleet-sheet information provided by the supplier, a list of all vehicles used within their operations and their motor class. Since the average of CO_2 emission is difficult to compare to one another, the average motor class compiled from the fleet sheets provides more comparative information. Today average motor class is only calculated for road transportations.

Within the sea traffic mode a new standard for measuring the supplier from an environmental aspect is developed within Sweden; the Clean Shipping Index. This index measures the shipping companies in several different areas such as; emissions to air, spill of waste water into the ocean, use of chemicals and the leakage of ground paint from the vessel into the ocean. The shipping companies enter data on their fleet of vessels making it possible for the cargo user to gain information and compare different shipping companies or vessels against each other. VLC is one of thirty large Swedish companies currently using the Clean Shipping Index and fourteen of the world's largest container carriers have entered data as well.

The demands put on the modes of air and rail needs to be developed further in order to be possible to monitor. Today, the traffic mode rail could be evaluated on its use of fuel, and if it is electrical trains the question on how the electricity was produced may be of interest to ask in the supplier survey. Regarding air, this traffic mode is seen as the "worst" from an environmental angle and should be avoided to the largest possible extent, but no calculations on emissions or other demands are brought forward from VLC to the concerned suppliers.

The suppliers of new material for emballage are asked in the supplier survey whether or not they are working in accordance to the black, grey and white lists provided by the Volvo Group with information on chemical substances that are forbidden, should be avoided or are approved to use. This is a pre-requisite for the suppliers during the pre-sourcing process in order to be considered included in the VLC supplier base, hence not as important in the evaluation work moving forward.

Safety

The safety issue is, to a large extent, connected to the safety of traffic such as the driver's use of seat belts, the use of alcohol and drugs, keeping the speed-limits and accurate handling of hazardous goods. These types of questions are compiled under the measurement of Overall Risk and is also included in the annual supplier survey and followed up through Transport Quality Audits performed by the Risk Management department where these questions are asked. For more information about the Risk Management's Transport Quality Audit, see section 4.6. The answer of the drivers from the Transport Quality Audit is then compared to the answers given by the supplier in the supplier survey. As seen below in figure 23 there is a deviation on what is reported by the suppliers in the supplier survey and what is detected when carrying out the safety audits. However, some deviations are positive; there is for instance a slightly higher number of drivers using seat belts than stated in the supplier survey.

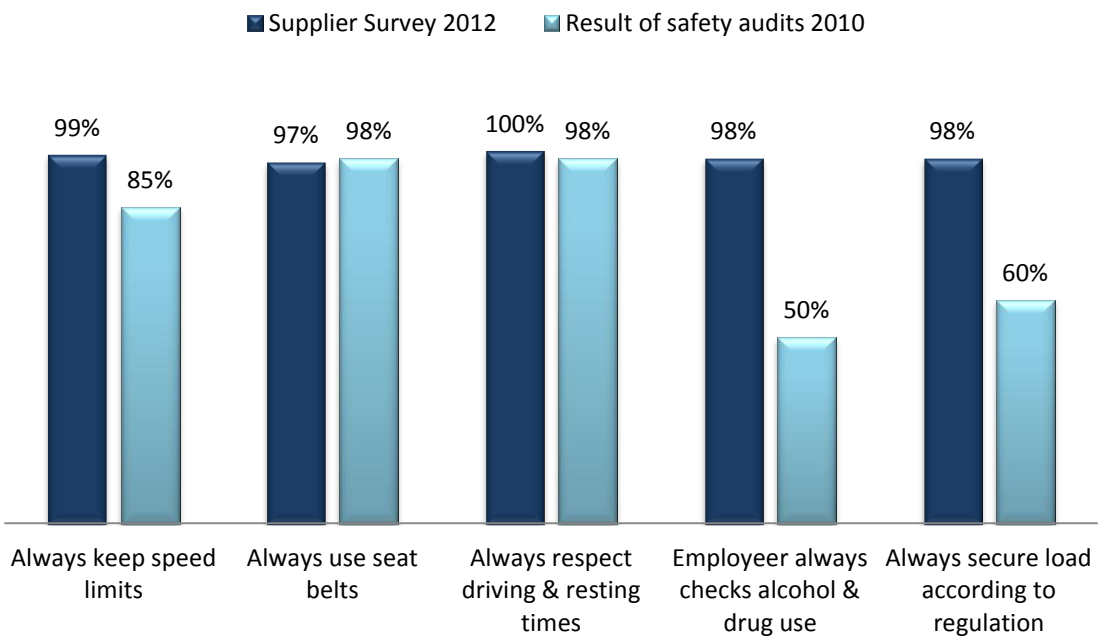


Figure 23; Comparison between suppliers' answer in supplier survey and result from safety audits, 2010..

There are other aspects to traffic safety as well, such as the laws and regulations of transportation. The regulations are the physical demands on the vehicle; correct breaks and tires, working lights as well as the regulations put on the drivers on driving and resting hours. The Operation Excellence department works in close connection to the Swedish police with these questions. The function participates, or gets reports on the outcome of performed inspections on vehicles carrying VLC goods. These types of inspections are carried out in Europe, mostly Sweden, and only on road transportations.

The supplier survey also includes the question whether the supplier has a contingency plan or not. This is a yes or no question asked mostly to ensure that the suppliers have such a plan, especially the emballage material suppliers, suppliers of logistic service centers or single-sourcing suppliers. If a situation arises where the capacity of the supplier to perform the contracted action is in trouble, VLC can put demands on the supplier to work through the problem. The supplier will have to use another solution, since the supplier has stated that they have a contingency plan and are prepared for possible disturbances.

4.5.2 Systems and identification

The input of data to the Operation Excellence department is provided by PS&S through the annual supplier survey. The supplier survey has three purposes for the department. First, to make sure that the demands put on the suppliers are being followed. Secondly, the information gathered enables the department to follow up on the environmental and core value goals for VLC and third, the data forms the basis for calculation. The calculations and analyzes of data are carried out through Excel-based solutions.

The supplier survey is sent to suppliers on a supplier group level; hence the information is only possible to access on this level. The survey is not global but limited to Europe. The supplier measurements that are related to Operational Excellence are included in table 14.

Table 14; Summary of Operation Excellence KPIs

Possible KPI:s	System (present)	System (future)	Identification	Global/Regional
ISO 9001	Supplier Survey	-	Supplier group level	Global
ISO 14001/Smart Way	Supplier Survey	-	Supplier group level	Global
Motor class, average	Supplier Survey	-	Supplier group level	Regional, Europe
CO_2 emissions, g/ton-km	Supplier Survey	-	Supplier group level	Regional, Europe
Clean shipping	Clean Shipping Index	-	Supplier group level	Global* (for suppliers based in Europe)
Contingency plan	Supplier Survey	-	Supplier group level	Global
CSR Compliance	Supplier Survey	-	Supplier group level	Global
Overall Risk	Supplier Survey	-	Supplier group level	Global

4.6 Risk Management

The insurance issue of the Volvo Group is handled by the Headquarters but the logistics part is delegated to the Risk management function at VLC. Risk management consists of four different departments; Insurance & Claims, Customer Relation and Quality Assurance where High and Heavy is an own department. The Insurance & Claims department handles the damages of cargo towards customers and suppliers; the customer relation department makes sure that the customers have the correct insurance coverage whilst Quality Assurance tries to prevent the accidents from occurring. The different insurance policies presented below are the backbone within the work of the risk management function, and from which everything is derived:

Cargo insurance; a property and casualty insurance bought for VLC's customers in order to insure the goods during transportation. The liability VLC has towards the customer through the signed contract is covered by this insurance. This is an all-inclusive insurance, first signed in 1947 and used globally as much as possible. However, there are countries that do not allow a global insurance, but instead requires a local insurance and hence a local policy from VLC. These countries are Brazil, China, Russia, India and the USA.

Freight forwarders liability, this insurance is for the third-party customers of VLC, companies outside the Volvo group. This insurance is not needed within the Volvo group, since liability insurance cannot cover the company's own operations.

Professional indemnity, this is consultancy liability insurance, applicable for the work of consultants within the Volvo group that covers loss of capital due to wrong counseling. This is mostly used within research and development.

Property insurance, this insurance covers loss of or damage to property of the Volvo Group such as buildings and terminals, but also machinery, computers and inventory. The general policy of the

Volvo Group and Volvo Group Real Estate (VGRE) covers most of these issues. Products may also fall within this category if they are on stock, as well as including emballage.

General liability, an insurance from the Volvo Group covering costs for a third-party and third-party's property if something is destroyed or damaged, for instance if a forklift drives with the forks into a parked car while unloading a truck.

When transporting goods, it is always partly insured by the freight forwarder, but only to a certain degree. How much is dependent on an entity called Special Drawing Rights (SDR) which is a foreign exchange reserve and the compensation is calculated with regards to the weight of the products. VLC's products is mostly heavy but this insurance is not enough for full coverage and it is extremely important to cover products with a cargo insurance, especially if they are light in weight but with a high value. The emballage used by VLC, is both light in weight and holds a low value. Therefore, the emballage is covered by the STR and additional insurance is not needed. This is the reason why the Risk Management function only covers the business areas Inbound and Outbound and not Emballage.

Besides different policies for different geographical areas there are also different laws and regulations in different countries. The securing of loads is one aspect where there are no general standard, not even within the EU. Therefore, pan-European transportations need to meet different requirements depending on country. At the loading, consideration needs to be taken upon which countries the transportation will go through.

4.6.1 Measurements

The analysis tool used within Risk Management, BAS (Business Analysis System), enables the user to look at accidents and cargo damages on a detailed level for each supplier, each market, product and lane. The supplier may be involved in a number of accidents but they will only be legally responsible for a part of these. There is a lead time for accidents; suppliers have twelve months to regress. Hence, it is not certain that the supplier is legally responsible of all accidents registered per month. This fact is important to consider when deciding upon which of the two numbers to include in the dashboard. The total number of accidents is important in order to improve the overall quality of the supplier even if the supplier is not liable for all accidents. However, if sharing the information of the dashboard with the supplier, it is important to explain how the number is calculated.

The Risk Management department and the quality assurance unit also perform transport quality audits of the suppliers. These audits evaluate the supplier on different aspects according to the handling instructions enclosed in all contracts. These handling instructions contain information on how to carry out the transportations of VLC goods, one for each traffic mode of sea, rail, road, air and yard-handling. A problem with suppliers not following these instructions may be that there are no common standards; hence all suppliers have different handling instructions for different customers. When the audits are carried out questions related to traffic safety issues are also asked for the Operations Excellence department, see section 4.5. The result of the Transport quality audits, excluding traffic safety issues, is ranked on a three-rated scale. If the supplier receives a lower score due to some issues not being performed according to the handling instructions, this is pointed out to the supplier who creates an action-plan and a new audit is carried out.

4.6.2 Systems and identification

Risk Management has built its own system together with Volvo IT called Risk Management System, (RMS). This system gathers information regarding audits, transportations, damages etc. The system is used globally and it is possible for the department to implement the system at new sites through its web based structure. RMS is connected to the system within Outbound, A4D. This connection makes it possible to compare the reported data on damages to the transportation data within A4D. Unfortunately this is not possible with the system within Inbound. ATLAS is being implemented across the Inbound organization but not yet in full use. That RMS is not fully integrated with ATLAS hinders the Risk Management in their work as the relevant data is not accessible.

BAS is an analysis tool that gathers information from a data warehouse, which stores information from numbers of systems within VLC. This information can be entered into BAS and then sliced and diced in order to analyze according to the specific needs. The data warehouse and the connection to A4D also make it possible to create reports towards the customers of Outbound, which is not possible for Inbound.

As identification of suppliers, PARMA-ID is used. The PARMA is chosen according to the contracts signed between the purchasing department and the suppliers. However, there are some problems with suppliers that have several PARMA-ID in use, especially within Inbound. The Risk Management related measurements are included in table 15.

Table 15; Summary of Risk Management KPIs

Possible KPI:s	System (present)	System (future)	Identification	Global/Regional
Transport Quality, number of damages	RMS	RMS	Supplier group level	Global
Transport Quality Audits	RMS	RMS	Supplier group level	Global

4.7 Invoicing & Cost Control

Invoicing & Cost Control (I&CC) is a department within the business function of Finance and Business control, a new organization since 2010. Business Control is a global support function responsible for the financial issues of VLC including IS/IT support of the financial systems (AB Volvo, 2012). I&CC holds responsibility for the verification and administration of both the incoming service invoices and for the invoicing of VLC's services to its customer. The mission of the department is to handle incoming and outgoing invoices in a correct, lean and timely way that contribute to the customer satisfaction and the shareholders' value, profit and cash flow. The aim is one hundred percent correct supplier and customer invoices and to utilize the payment terms of incoming and outgoing invoices in order to secure a positive cash flow (AB Volvo, 2011).

Within the I&CC department there are different units for each business area; I&CC Inbound, I&CC Outbound and I&CC Emballage. The different units handle the incoming and outgoing invoices related to their specific business area and each have specific goals and requirements regarding system support.

4.7.1 Measurements

The invoices are entered into the invoicing system used within I&CC, Contracting & Invoice Control (CIC), either by EDI (Electronic Data Integration) or manually by VBS (Volvo Business Services). The system compares the data for an automatic match. If everything is in order, the invoice is sent on to SAP for coding, verification and payment, which is done by VBS. The I&CC units do not need to do anything if this match is complete. However, if for some reason there is no match, a series of actions is required. An invoice that does not match automatically will be parked and labeled either; not handled yet, price block quantity block, awaiting credit or incomplete invoice by the person who then manually handles the invoice. These labels help determine why the invoice was not matched directly and where to gain the information needed for a manual match. A division is also made between carrier disputes and internal problems where carrier disputes refer to issues with the quality of the supplier's invoice. Price block means issues with the cost of the transportation and if the problem is internal, the responsibility lies with the purchasing department. Quantity block, on the other hand, means issues with the transportation data and if internal, the responsibility lies within the traffic department.

Overdue amounts are another measure used within the I&CC organization. This is invoices that for some reason have not been paid on time, and the metric is followed up extensively. The overall goal is to have zero overdue invoices but VLC will not pay an invoice just in order to reach this goal. There are invoices where VLC are in a dispute with the supplier since VLC believes that the invoice is incorrect, and then the invoice will not be paid until the issue is resolved. There are different codes for why the invoice is overdue for follow-up. This is carried out, not only within the business areas but also on a supplier group level. This information is relevant in a situation where the supplier contacts VLC and asks why the invoice is overdue. The KPIs that are presented above and related information are included in table 16.

Spend per supplier is possible to measure through the invoiced amounts per supplier for a specific time period, such as on a monthly basis. This data is stored at the data warehouse and possible to extract through reports. However, currently this is only possible to extract for the European operations but once the IT project of LES is implemented this will be possible to do on a global scale.

When a new contract is to be negotiated within the purchasing department, I&CC should be involved in the tendering process in order to evaluate the potential invoicing quality in beforehand, and the possibility of automatic matching in CIC. Today, there are problems with how the transportation flows and hence the invoices are set up in order to generate automatic invoicing match. By involving the I&CC department early on in the procurement process, the hit rate in CIC may be improved by designing the new transportation flows in a certain way. However, this is always an assessment and a trade-off that needs to be made between operations and I&CC-fit. If the proposal from a carrier is better from an I&CC perspective but another supplier is better and with a lower cost on the operational side the I&CC department can approve on a lower invoicing quality. This is a factor that is important when deciding on the performance levels on each individual supplier.

Inbound, Outbound and Emballage set their KPIs and goals to reach as well as develops how the internal feedback will be designed. A common report is sent out on a monthly basis from the process development I&CC unit; covering the performance of all units. This report covers aspects of number

of invoices and invoice lines per GBO, parked invoices and overdue amounts, both on a general level and divided on each GBO.

Within each I&CC unit the employees are divided into geographical groups such as Europe, domestic and overseas, and all employees have their specific suppliers that they are responsible for. When a problem arises that cannot be solved internally the first contact with the supplier is always done by this person, trying to solve the problem before escalading it to another level, for instance the purchasing department.

4.7.2 Systems and identification

Each GBO; Inbound, Outbound and Emballage, has their own transportation system for handling all data related to the carried out transportations. All data regarding the transport that is relevant for matching the incoming invoices to VLC is sent to I&CC's system CIC, this information is called Sjob and is structured in a certain way according to specific rules. All performed transportations get a unique reference which also is used by the carriers when creating the invoice. Figure 24 visualizes the information flow and system support for handling invoices within I&CC.

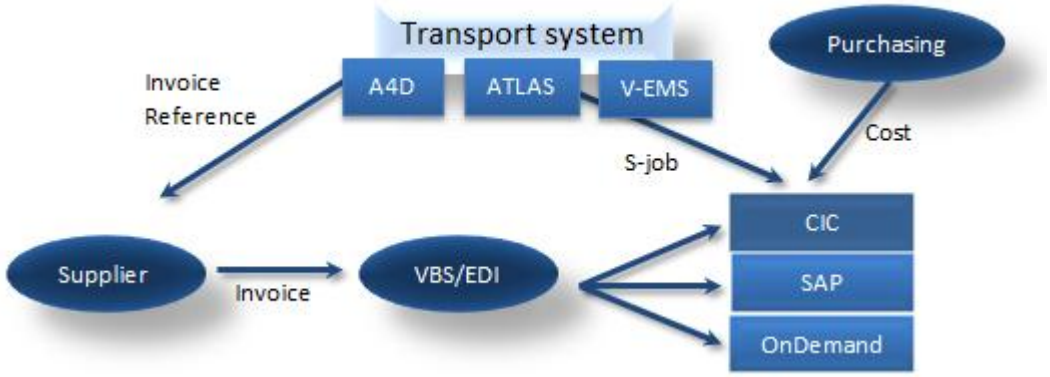


Figure 24; Visualization of the information flow and system support for handling invoices. Source: (Volvo Logistics Corporation, 2010)

From the Global purchasing department the information agreed upon between VLC and the supplier in the transportation contracts as well as prices are entered into CIC, and this information together with the Sjob creates VLC's reference when controlling the incoming invoices.

The supplier creates an invoice with a corresponding reference to the one created by the traffic department at VLC, and the invoice is send to VLC either by Electronic Data Interchange (EDI) where the invoice goes directly into CIC at each I&CC unit. The information in CIC does not provide a picture of the original invoice, which instead can be seen in OnDemand. If the invoice is sent by paper it is registered and transcribed into CIC by VBS. However, there are invoices that cannot be sent this way, for instance invoices regarding additional costs. There is also a monetary aspect of wanting a high rate of EDI invoices since I&CC have to pay VBS 18 SEK per invoice line in order for them to transcribe the data into CIC.

The PARMA-ID is closely linked to the invoicing process and hence all measurements and follow-up is done with the PARMA-ID as common identification. There is a problem within the I&CC organization that the PARMA-ID sending the invoices is not always the correct PARMA-ID according to contracts,

although correct supplier has carried out the transportation since there are numerous PARMA-ID connected to each supplier on a supplier group level. Within the I&CC organization this is handled through sub-coupling the different accounts. This is not a major problem for the I&CC organization, today there is no possibility to measure the suppliers invoicing performance on contract-level, but if this would be asked for in the future the sub-coupling would need to be reorganized in order to secure that the correct PARMA-ID's are connected to the correct contracts number. When CIC will be replaced by a SAP solution from the LES project, the issue with sub-coupling will have to be handled. Table 16 summarizes the I&CC related supplier measurements.

Table 16; Summary of I&CC KPIs

Possible KPI:s	System (present)	System (future)	Identification	Global/Regional
Number of parked invoices due to supplier errors, divided by total number of invoices (Invoice quality)	CIC/SAP	LES	PARMA-ID	Regional, Europe
Number of automatically matched CIC lines/total number of CIC lines	CIC/SAP	LES	PARMA-ID	Regional, Europe
Number of overdue invoices/total number of invoices	CIC/SAP	LES	PARMA-ID	Regional, Europe
Number of parked invoices/total number of invoices, defined according to labels	CIC/SAP	LES	PARMA-ID	Regional, Europe

4.8 Summary of the empirical findings

- Today, no standardized way for evaluating suppliers exists within the purchasing department. Different levels of follow-up exist in and between the different business areas as well as between purchasing and other departments.
- The Supplier performance dashboard at VLC should fulfill the following requirements:
  - ✓ The dashboard shall provide an overall view of each core supplier on group level i.e. one screen image of the performance levels within the central KPIs that represent the most important requirements VLC puts on its core suppliers.
  - ✓ It should be possible to view the supplier's performance within a specific business area; Inbound, Outbound and Emballage.
  - ✓ It should be possible to track trend over time to identify improved or worsened performance.
  - ✓ It should be possible to drill down or aggregate up the data to supplier group level, PARMA-ID, contract and flow level in order to view the supplier's level of performance within different regions and specific flows.
- VLC has 154 core suppliers that account for 90 percent of total spend. Interviews with five of the largest suppliers showed that the suppliers were positive to a supplier performance dashboard and desired to take part of the information in the dashboard.
- The purchasing department has designed generic contracts for the different commodities. Attached to the contracts are the SOPs that describe the required levels of performance from the suppliers. The SOPs are created by the GBOs.
- Seven different departments of VLC measure supplier performance. These departments are illustrated in figure 25 in the shape of the diamond model that has been derived from the theory chapter. The results show a decentralized structure for supplier performance measurements within VLC with several points of interaction between VLC and the supplying firm.

Figure 25; Illustration of the decentralized supplier measurement structure at VLC where several departments are responsible for different measurements.

- Table 17 summarizes the different measurements that are carried out by the different departments within VLC. The table is divided into three parts depending in the characteristics of the measurements; financial, operational and core value related measurements and KPIs. The operational measurements are further divided into Inbound, Outbound and Emballage

related measurements. For a more detailed summary of the present and future systems, identification, and regional or global data collection, see appendix 5.

Table 17; Summary of all possible KPIs to include in a dashboard, divided with regards to financial, operational or core-value orientation.

Possible Financial KPIs	Possible Operational KPIs	Possible Core-Value KPIs
Financial Ranking	IB -Delivery precision	ISO 9001
Spend	IB-Pick-up precision	ISO 14001 / SmartWay
Number of registered CIC lines	IB-Lead-time	Motor class, average
Number of automatically matched CIC lines / total number of CIC lines	IB-Deviation Reporting	CO2-emission, g/ton-km
Number of overdue invoices / total number of invoices	IB/EMB-Unloading precision	Clean Shipping Index
Number of parked invoices / total number of invoices, according to labels	IB/OB-Transport Quality	Contingency plan
	OB-Arrival reporting	Transport Quality Audit
	OB-Departure reporting	
	OB-Lead-time	
	OB-Delivery target fulfillment	
	EMB – Delivery Precision	

- There is no standardized systems environment within VLC. Each business area and department have developed and implemented its own system.
- The system that is connected to supplier identification within VLC; PARMA, contains some inconsistency. A supplier that has a specific PARMA-ID in one system may have a totally different PARMA-ID in another system. This can create unreliable measurements since one supplier may incorrectly, be connected to the wrong PARMA-ID. One of the reasons behind the inconsistency is that all systems are not updated when a supplier gets a new PARMA-ID. Furthermore, PARMA has no limit for creation of new ids for a supplier which means that one supplier may have several ids in PARMA.

5 Analysis

The theoretical and empirical findings will form the basis for the analysis chapter. The main focus in the analysis is to make an evaluation of all the KPIs that were identified in the empirical chapter. The evaluation and analysis is structured around four areas that have been identified to affect the content of the dashboard as illustrated in figure 26. The areas are; Purchasing objectives and VLC requirements, Technical restrictions, Characteristics of KPIs and Organizational representation. Step by step, the number of KPIs will be reduced and the analysis chapter will end up in a number of KPIs that should be included in the dashboard. The analysis will also include suggestions for KPI visualization in the dashboard and a recommended implementation process. These aspects are presented in chapter 5.7.1 and 5.8 respectively.

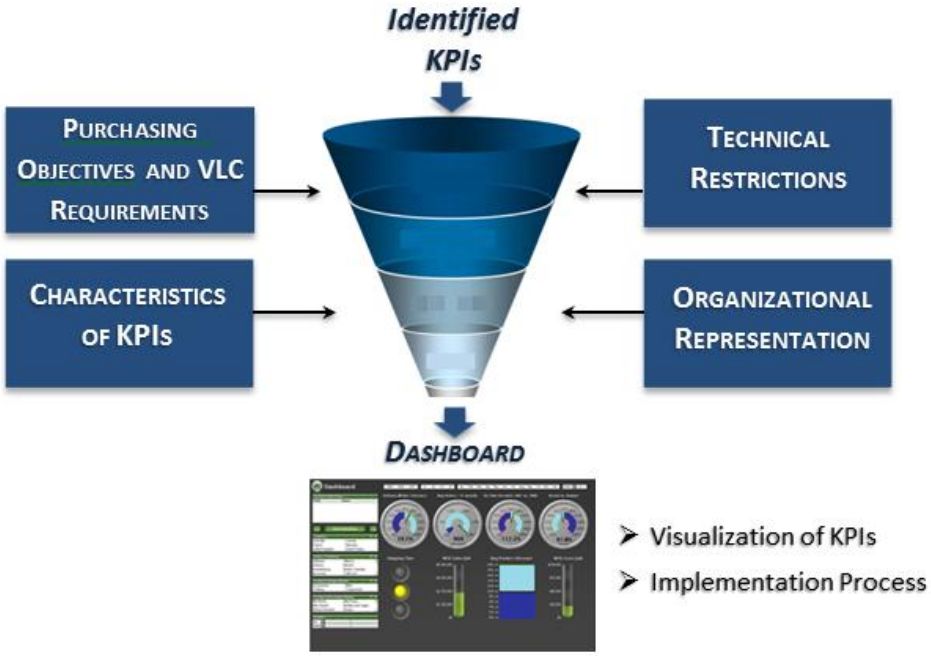


Figure 26; Illustration of the analysis process. The figure includes the four areas of evaluation; Purchasing objectives and VLC requirements, Technical restrictions, Characteristics of KPIs and Organizational representation

The four areas in figure 26 will be covered in the following way:

Purchasing objectives and VLC requirements – This aspect is discussed in chapter 5.1. Focus is on how dashboards can be a tool to help fulfill purchasing objectives in general and the requirements and needs of VLC purchasing in particular.

Technical restrictions – Technical restrictions will affect what information is possible to include in the dashboard. In chapter 5.2, the KPIs are evaluated from different perspectives but much focus is on accessibility of data. The chapter also includes an assessment of the possibilities for automatic transferring of data that would limit the needs for manual data input.

Characteristics of KPIs – The characteristics of KPIs can be evaluated from many different perspectives. In the end of chapter 5.2, the KPIs are ranked according to a number of different criteria that were identified in chapter 3.3. Chapter 5.3 includes an assessment of the KPIs based on the framework that was developed in chapter 3.3 and its subchapters. The purpose of this assessment is to investigate the level of balance between the chosen set of KPIs and measurements.

Organizational representation – The fourth area of consideration, organizational representation, will be covered in chapter 5.4 and 5.5. In these sections, the KPIs will be evaluated based on which department of VLC they represent and which traffic modes they are relevant for. This is to ensure that the dashboard will be as comprehensive as possible; that it covers all modes when applicable and that the relevance and usability is maximized in order for the dashboard to apply to all potential stakeholders.

5.1 Dashboard for purchasing

In the literature review, it was found that the purchasing department has several objectives. Some of these objectives do specifically relate to the relationship to the suppliers and are more relevant for the purpose of this thesis. In the following list, those purchasing objectives have been identified:

- To maintain effective relationships with existing suppliers and develop alternative sources of supply in order to ensure continuous supply.
- To buy efficiently and wisely. With ethical means, obtain the best value for the money spent.
- To select the best suppliers in the market.
- To maintain a correct balance between quality and value.
- To perform supply management in an environmentally responsible way.

To fulfill these objectives, the purchasing department needs access to relevant supplier information in an efficient way in order to support decision making. Continuous evaluation of the suppliers is important in this aspect; to collect information about the suppliers' operations and their performance. Supplier assessment is many times even more relevant in logistics service procurement, since the performance of the logistics provider will have a direct impact on the service provided to the end customers. Primarily, this concerns operational performance, however, it is still important to monitor the supplier's performance within other areas as well.

Many companies struggle with a vast amount of information, generated by various disparate reporting systems. The relevant data is not readily accessible when the decision maker is in direct need of the specific information. It is in this context the supplier performance dashboard is relevant. Eckerson (2011) uses the term performance dashboard which he defines as: "a layered information delivery system that parcels out information, insights, and alerts to users on demand so they can measure, monitor, and manage business performance more effectively". Deployment of dashboards is an attempt to create a simplified picture of a complex reality. The dashboard is a tool that brings together the most relevant data that is needed for efficient decision making. Reducing the need to create and maintain large numbers of static reports was identified by Rasmussen et al. (2009) as one of the benefits of dashboards. The authors also mention ability to identify and correct negative trends and to improve measurement analysis as positive outcomes of dashboard deployment.

Relating back to the list of objectives for purchasing that was presented above, a dashboard may address these areas of responsibility in different ways. The first point, to maintain effective relationships with the suppliers, can be supported by information in a dashboard. A comprehensive overview of the most relevant KPIs helps identify problem areas that need improvement; it can also mean to communicate these areas of improvement to the suppliers in order to collaborate on a solution for better performance. For assessment of new suppliers, the dashboard will not include operational data which means that a dashboard is more appropriate for existing suppliers. Concerning the second and fifth point, the dashboard can provide relevant information about the

suppliers that covers environmental and ethical aspects. The dashboard can display whether the supplier has ISO certificates, it can provide an indication about rate of emissions and information about the attitude towards CSR related issues in general.

The dashboard can also help identify the best suppliers in the market which is the third objective of purchasing. By comparing the performance levels of different suppliers it is possible to identify the supplier with the best performance rates. Again, it will be difficult to include and compare new and unproven suppliers for an overall assessment but still, a comparison between existing suppliers is fully possible. The fourth objective is to maintain a balance between quality and value and the dashboard can also be an assisting tool in this context. The general performance level of the suppliers and particularly, the operational performance levels, indicate what quality the supplier provides; the better the performance, the higher the quality. However, it can be difficult to assess what value this implies, the turnover per supplier indicates the money spent but a relative figure representing value versus performance can be more difficult to display.

5.1.1 Areas of dashboard application at VLC purchasing

VLC is not the only company that desires to enhance decision making through dashboard support. In its study among 285 firms, the Aberdeen Group (2009) found that the primary motives to why companies drive dashboard initiatives is to gain visibility into key business processes and to replace decisions based on gut feeling with decisions based on facts.

Today, VLC measures its suppliers within several areas; different departments within the company carry out various forms of supplier measurements. For instance, requirements connected to the core values are covered by the supplier survey and the RFIs, operational performance are measured by the GBOs and I&CC keeps track of the supplier invoicing quality. The problem is that only a part of this information reaches purchasing; the function cannot today get a holistic view of the supplier performance that represents all areas of supplier performance requirements. Supplier evaluations and sourcing decisions are too often based on vague perceptions of individuals and there is a lack of supporting facts.

This was also the main intension behind the initiation of the dashboard project within purchasing at VLC; the function needs a tool that provides the most relevant data about the suppliers for more efficient decision making. Since it is desired to use the dashboard in several different contexts, it requires the dashboard to be generic and not too specific for a certain situation. VLC has mentioned the Supplier Management Forum to be the main area of dashboard application. In this forum, representatives from different departments within VLC will participate and the intension is that the members of the forum will meet on a monthly basis. Supplier assessment on this, more overall level puts certain requirements on the content of the dashboard; these specific requirements are listed below:

- The dashboard shall provide an overall view of each core supplier on group level i.e. one screen image of the performance levels within the central KPIs that represent the most important requirements VLC puts on its core suppliers.
- The dashboard shall represent the interest of all the stakeholders of the forum
- The KPIs shall be relevant for all traffic modes
- The suppliers are presented on supplier group level
- The KPIs represent all the operations globally

- It should be possible to view the supplier's performance within a specific business area; Inbound, Outbound or Emballage.
- It should be possible to track trend over time to identify improved or worsened performance.
- Possible to link the overall performance to a more detailed report in order to identify root causes

In the succeeding chapters of the analysis, the KPIs from the empirical chapter will be evaluated in detail, where there will be specific consideration on the requirements that are listed above. Evaluation of the KPIs will help adjust the content of the dashboard to meet these requirements. In the end of the analysis, there will be a discussion about the KPIs that are finally chosen to be included in the dashboard where the main focus will be on how well the requirements are fulfilled by the dashboard.

During the study, three additional areas of potential dashboard application within purchasing at VLC have been identified:

- Strategy Development
- Purchasing Managers
- Purchasers

Actors within these three areas have different agendas; the focus of their work differs and when it regards issues related to supplier assessment, the actors have different areas of importance and prioritization. That means that the requirements on the content and functionalities of a supplier performance dashboard may differ between these three groups of people. However, regardless of what issues are important and should be prioritized within each area, the main purpose of the dashboard is that it shall provide the viewer with a comprehensive view of the suppliers' most important performance indicators. The more possibilities for data drill down and aggregation, the more useful the dashboard will be as an analysis tool. Therefore, it is possible to identify a list of general requirements that apply for all of the areas that were listed above:

- The dashboard shall provide an overall view of each core supplier on group level i.e. one screen image of the performance levels within the central KPIs that represent the most important requirements VLC puts on its core suppliers.
- It should be possible to view the supplier's performance within a specific business area; Inbound, Outbound and Emballage.
- It should be possible to track trend over time to identify improved or worsened performance.
- It should be possible to drill down the data to PARMA, contract and lane level in order to view the supplier's level of performance within different regions and specific lanes. For illustration of the different levels of aggregation, see figure 27. Important to note is that this requirement only applies for the operational and the financial KPIs except for the financial ranking KPI. The reason is that it is not convenient to measure the remaining KPIs other than on supplier group level.

Figure 27; Illustration of the four levels of information identification

5.2 Assessment of potential KPIs

In the empirical chapter, the most important measurements and KPIs within each department were identified. A list that summarizes these KPIs is found in Appendix 5. In the following chapter, each KPI is presented again, along with an evaluation and short motivation why it should or should not be included in the dashboard. The assessment has been made with specific consideration on the requirements of a performance dashboard that were identified in chapter 3.4.3. The most relevant in this case are:

- *Monitor KPIs.* The dashboard shall illustrate the critical KPIs that are needed for effective decision making within the domain the dashboard serves.
- *Accurate.* The information that is included in the dashboard must be completely accurate in order to reach full user confidence in the dashboard. The data must be well tested and validated before included in the dashboard.
- *Timely.* The information must be real-time and right-time; it must be updated to the latest version possible in order to achieve effective decision making.

The first point is, to some extent, considered in this chapter. Mainly when motivating the relevance of the KPIs to VLC purchasing. However, this aspect is integrated and evaluated in more detail throughout the succeeding sections of the analysis chapter. Instead, in this chapter, most emphasis has been put on the second point; to conclude what is actually measured within VLC today and assess the accuracy of these measurements. The third point is also relevant but due to the fact that the requirement on the dashboard at VLC is not to be updated more frequently than monthly, there has been more of an assessment on the updating frequency than on whether the data is timely or not.

This section is structured around the different KPIs and other measurements that were identified in the empirical chapter. The chapter consists of two parts; first, there is a general assessment of each KPI or metric and in the second part, a ranking of the different measurements according to the criteria presented in theory chapter 3.3 is included. In section one, each measurement or KPI is evaluated based on the following structure:

Structure:

1. Purpose and importance of the KPI
2. Method and responsible department for measurement within VLC
3. Motivation to why the KPI should be included in the dashboard or not. Description of possible frequency of update

In connection to each metric evaluation, a figure is presented that summarizes the findings. For consistency reasons, all the measurements are denoted KPIs in the figures even if some of them in more correct terms should be denoted metrics or measurements.

Financial Ranking – The financial ranking is an important metric as it can give an indication of the financial risk of the supplier. It is especially relevant to assess the financial risk of the most critical suppliers that either accounts for a large share of the turnover or suppliers that are single providers of a product or a service where the options for alternative suppliers are limited. Financial stability is essential in order for the supplier to be able to continue to operate the market and provide VLC with the services needed.

Currently, financial ranking for the suppliers is provided by a financial institute and the information is manually entered into an excel sheet. A future prospect is that this data is directly fed into the dashboard system instead of an excel file which would mean that the data is readily accessible in the system. The data is only registered on supplier group level, however, in most cases; the financial risk figure will also apply for subsidiaries and entities within the corporation since the financial risk is most often covered by the parent company.

To conclude, this measurement is possible to extract and should be included in the dashboard. It is most realistic to update the numbers yearly even if European figures may be updated more frequently. The more frequent updates the better basis for accurate decision making of course. However, it should not come at the expense of any additional manual work; more frequent updates must come automatically. Figure 28 summarizes the previous findings regarding the financial ranking measurement.

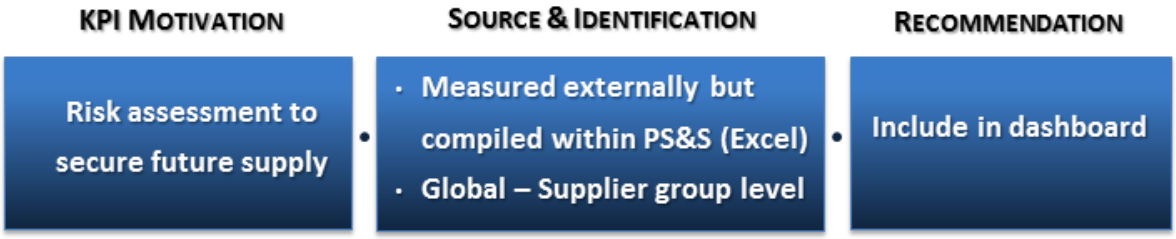


Figure 28; Summary of the current status of the financial ranking measurement; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

Spend – The turnover per supplier is important information as it provides an indication of the importance of the supplier; the larger spend, the more important the supplier is. However, it should be remembered, that also a relatively small supplier can be as important if it is critical to VLC's operations. There are regions where a supplier is the only alternative and in that case, the spend data is not a sufficient indication of the relative importance. Nor will the spend be an accurate indication for the small suppliers that are strategically important as they operate critical lanes of traffic or where there are specifically developed set ups of transportation.

PS&S is responsible for the compilation of a spend report. This is done manually in an excel sheet. Due to system disparity, it is not possible to collect global spend data in a convenient way more frequent than semi-annually. However, if limiting the focus of the dashboard to only European suppliers, the spend data could be updated monthly by extracting data from the I&CC department

and the data warehouse. Suppliers are assessed on PARMA-level and it is possible to aggregate the information up to supplier group level.

Despite the fact that the turnover is not exclusively an indication of the supplier's importance it is useful and should be included in the dashboard. Considering the current system conditions at VLC, it is only convenient to update the turnover per supplier on a semi-annual basis in connection to the creation of the global spend report. What is possible and most convenient today is to extract the spend data for the core suppliers from the global spend excel sheet, but direct entry into a dashboard system will simplify the process. Figure 29 summarizes the previous findings regarding the spend metric.

Figure 29; Summary of the current status of the spend metric; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

Number of parked invoices due to supplier errors divided by total number of invoices (Invoice quality) – Invoice quality is an important KPI as low invoice quality implies hidden extra costs that come from additional administrative work and manual rework. Automatically approved invoices are desired but as soon as an invoice does not match in the system, administrative work is required to track the source of error and make corrective actions, which may be costly in the long term.

The number of parked invoices due to supplier errors is measured by the I&CC department and the figures are currently stored in the department's system CIC. When extracting the numbers, it only provides a snapshot of the instant situation i.e. the current number of parked invoices due to supplier errors at the specific moment. The present system is only covering the European operations but the future implementation of the ongoing LES project will enable global measurements.

When assessing the invoice quality, the I&CC department measures primarily four KPIs. However, what is considered relevant when it comes to assessing supplier performance is number of parked invoices divided by the total number of invoices. In this case obviously, it is only the number of parked invoices that are caused by the suppliers that are relevant as it determines the supplier performance. This KPI should be included in the dashboard as low performance may imply considerable costs and the KPI can reveal underperforming suppliers that require corrective actions. Due to the current system restrictions, that only include measurements of European operations, it is recommended to await the implementation of the LES project until the invoice quality KPI is included into the dashboard. For the purpose of the dashboard, monthly updates are most appropriate. The invoice quality KPI will be readily accessible which means that it can be automatically updated according to a monthly frequency. Figure 30 summarizes the previous findings regarding the invoice quality KPI.

Figure 30; Summary of the current status of the invoice quality KPI; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

IB Delivery Precision – VLC is highly dependent on the operational performance of the suppliers. Poor operational supplier performance will have an immediately negative impact also on the operations of VLC's customers. Delivery precision has been identified in several studies as one of the most important transportation KPIs (Birkland, 2002; Menon, et al., 1998; Gunasekaran, et al., 2004). VLC and its suppliers have agreed on required performance levels that are included in the contracts. It means that VLC can put specific demands and take action against the suppliers who do not fulfill these requirements. Delivery precision is especially important in Inbound transports where JIT delivery is a prerequisite for an efficient flow and avoidance of disruptions in production.

Delivery precision is measured by the GBO Inbound but today, the information is stored in different systems depending on the geographical location of the operations. This creates difficulties to automatically extract figures that have a global representation. Within the different systems, there are also different definitions of the metrics of Inbound and it is not certain that all systems measure the same metrics as it depends on what the customer demands. For the European operations, operational data can be found in TIR and FADS, while the operations in the US are using ATLAS. When ATLAS has been rolled-out globally it will be possible to achieve more consistency in the measurements and it is expected that data can be extracted automatically from the system and be transferred into the dashboard.

Since the suppliers' operational performance is such important to the operations of VLC and as it has direct impact on the customer service provided to VLC's customers, it is recommended to include delivery precision in the dashboard. However, due to the current system disparity and inconsistency in metric definitions, it is not convenient to set up solutions for transferring of data from all the different systems today. Instead, it is recommended to wait with implementation of this metric until ATLAS has been rolled-out globally. In order to enable comparability of data, delivery precision should be included in the dashboard in terms of target fulfillment. The updating frequency should, preferably be on a monthly basis. Figure 31 summarizes the previous findings regarding the IB delivery precision KPI.

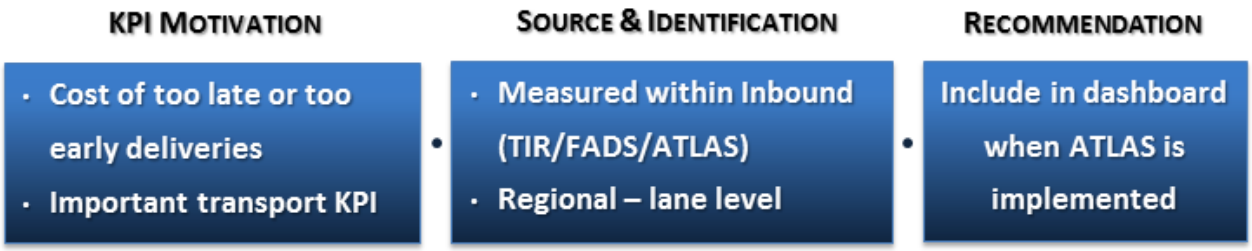


Figure 31; Summary of the current status of the IB delivery precision KPI; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

IB Pick-up precision – Pick-up precision is an important operational measurement, especially for the purpose of predictability and planning at the pickup position. Besides that, a similar reasoning applies for pick-up precision as for delivery precision, whereby the reader is referred to the section *IB Delivey Precison* for more details regarding purpose and importance of the KPI.

See IB Delivery Precision for information about how the KPI is measured.

Pick-up precision is a relevant measurement that should be included in the dashboard. However, due to system restrictions it is not feasible to include the KPI in the first implementation stage. *See IB Delivery precision* for more details about motivation and updating frequency. Figure 32 summarizes the previous findings regarding the IB pick-up precision KPI.

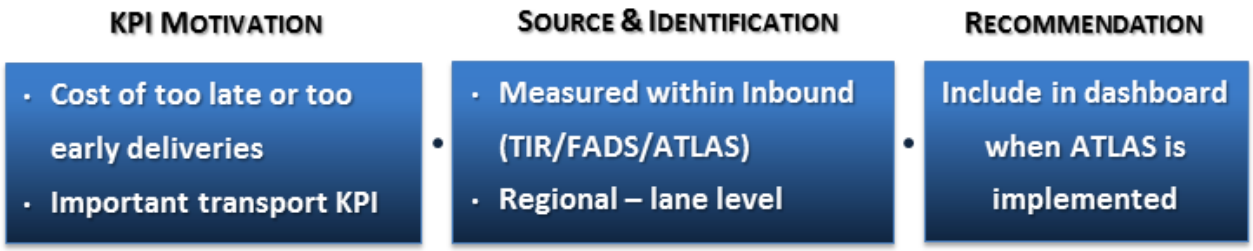


Figure 32; Summary of the current status of the IB pick-up precision KPI; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

IB Lead time – In the theory chapter, it was shown that lead time, or transit time was one of the most important transportation KPIs. Accurate transit time is also something the GBOs Inbound and Outbound emphasize as being important for their operations. Transit time deviations make it difficult to plan logistics activities and coordinate material flow, especially within the Inbound operations. There is a connection between, transit time, pick-up- and delivery precision; if the carrier performs well on two of the KPIs, it is evident that the third KPI is accurate as well. However, to get better measurements it can be reasonable to measure all three KPIs.

Lead time is measured within the GBO Inbound but the information is stored in different systems depending on the geographical location of the operations. *See IB Delivery Precision* for more information about systems and measurements.

Lead time is an important operational KPI that should be included in the dashboard. However, due to system disparity, it is not recommended to include lead time under the current conditions, but to wait until ATLAS has been rolled-out. *See IB Delivery Precision* for more details about motivation and updating frequency. Figure 33 summarizes the previous findings regarding the IB lead time KPI.

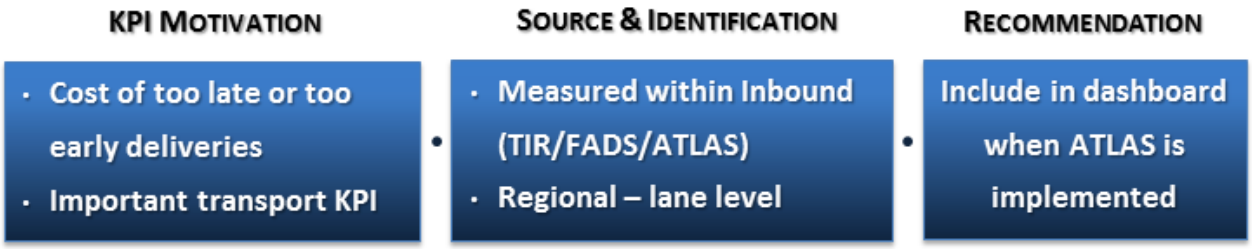


Figure 33; Summary of the current status of the IB lead time KPI; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

IB Deviation reporting – For the Inbound operations, it is highly important that the deviation reporting is of high quality in order for the GBO to be able to take corrective actions against any

transportation delay or disruption. It is important that the administration and collaboration with the supplier works efficiently as it will have an impact on the level of performance in the physical operations.

Inbound is the only GBO that monitors deviation reporting and the department require one hundred percent reporting from the suppliers. Due to system restrictions, it is not possible to automatically extract data of this KPI with a global coverage. *See IB Delivery Precision for more details on this issue.*

As mentioned, the deviation reporting KPI is of outmost importance for efficient operations at the Inbound GBO. However, since there is currently no common system for measurement for this KPI, it is not recommended to include it in the dashboard until ATLAS has been implemented. Figure 34 summarizes the previous findings regarding the IB deviation reporting KPI.

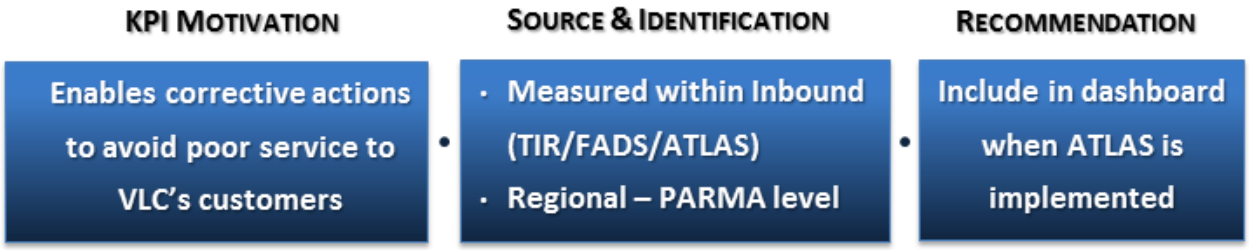


Figure 34; Summary of the current status of the IB lead time KPI; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

IB EMB Unloading precision – Unloading precision is a KPI that is similar to pick-up precision; it represents how accurately the packaging material is picked up in time. This KPI is important for the emballage transportation operations and especially for the planning activities in the terminals were the material is picked up. Material that is not being picked up in time occupies terminal space and there is also a risk that emballage material will not be available in time when needed.

This KPI is measured within the GBO Emballage and as previously mentioned, it refers to the transportation of emballage and not to the suppliers of new packaging material. The measurement is registered in the Emballage system V-EMS on a supplier ID called Emballage IP. The pickup registrations are carried out in the terminals where the employees enter different error codes into the system depending on type of error.

Since the unloading precision KPI is only measured in Europe and the information is stored in a system, V-EMS where data cannot be easily transferred into other systems, it is not recommended to include this KPI in the dashboard with the current conditions. Also the robustness of the KPI; that it really represents the performance of the supplier and not errors made by any other party, can sometimes be hard to ensure. The measurement depends on what code of error is registered into the system and the carrier does not always agree upon who is responsible for material not being picked up. Nevertheless, with better system support, possibly from the LES project, the unloading precision KPI may be relevant to include in the future. However, with consideration to the current conditions, it is not recommended to include this KPI. Figure 35 summarizes the previous findings regarding the IB EMB unloading precision KPI.

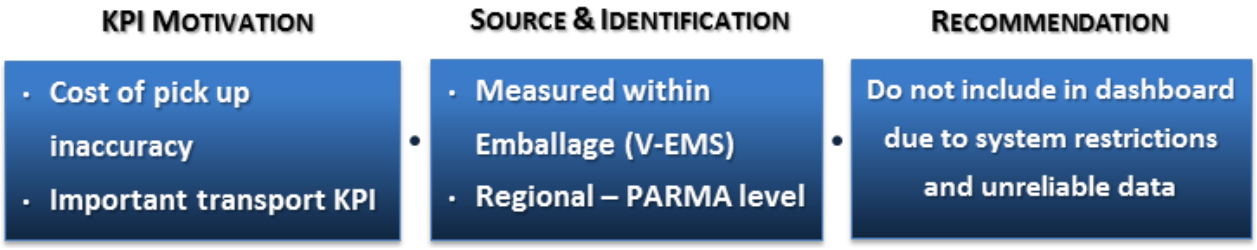


Figure 35; Summary of the current status of the IB EMB Unloading precision KPI; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

EMB Delivery Precision – Currently, it is not possible to measure delivery precision for suppliers of new packaging material. However, it is something that is desired by the GBO Emballage and it is important for capacity planning and supplier performance measurement.

Due to system restrictions, the performance of packaging suppliers cannot be measured today. However, in the ongoing LES project, the intension is to include functionalities for supplier delivery performance measurement on supplier group or PARMA level. However, the possibilities created by the new system were not yet fully established while this thesis was carried out. Nevertheless, it is something that is relevant for further investigation for potential future dashboard inclusion.

Due to system restrictions, the EMB delivery precision is not possible to include in the first stages of the dashboard implementation. However, it is something that deserves further investigation for potential future dashboard inclusion as earlier mentioned. Figure 36 summarizes the previous findings regarding the EMB delivery precision KPI.

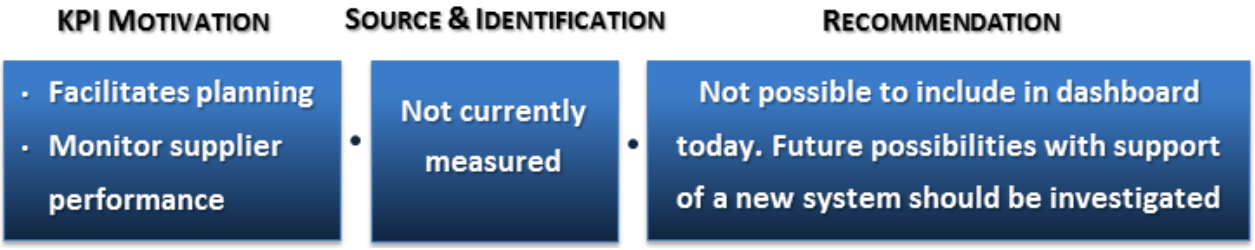


Figure 36; Summary of the current status of the IB EMB Delivery precision KPI; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

Transport quality – Transport quality is a measurement of the rate of damage free deliveries and it is an important KPI for several reasons. First of all, damaged goods cause disruptions in the material flow which may induce considerable costs due to loss in production. Repeated quality issues will lower the delivery reliability which in turn, will demand for higher safety stock that generates increasing inventory costs. The administrative cost for handling the damage claims will also grow as the rate of damaged goods increases.

Risk Management is responsible for registration and follow-up on transport quality issues and damaged goods. The information is stored in the Risk Management system RMS where there are information both on total number of incidents that the carrier has been involved in as well as the figure representing the numbers of incidents where the carrier is legally liable. The latter number will

not be as timely as the total figure due to incident resolution; it can take up to twelve months until liability or not is decided. The data can be presented on either lane, PARMA or supplier group level.

Transport quality is a very important operational KPI. It is accurately measured by Risk Management and for these reasons it should be included in the dashboard. The recommendation is to choose the figure representing the total number of incidents since it is timelier and because it is important to be aware of the total rate of incidents regardless of the liability of the carrier or not. However, it is important to be clear, especially towards the supplier about how the numbers have been identified. The information can be updated monthly and it is therefore recommended. Figure 37 summarizes the previous findings regarding the transport quality KPI.

Figure 37; Summary of the current status of the IB lead time KPI; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

OB Delivery precison – *see IB Delivery precision for purpose/importance of KPI.*

In A4D, the data is registered per lane but the system allows aggregation of data up to PARMA level as well as supplier group level. The aggregation of performance results from different lanes and regions is possible since Outbound focuses on precision in terms of target fulfillment. By measuring to what degree a supplier fulfills an agreed level of performance, a measurement that determines the target fulfillment is achieved. The information in A4D is frequently updated whereby it is possible to keep a monthly update of the delivery target fulfillment KPI in the dashboard.

Delivery target fulfillment is an important KPI that measures operational performance, it is accessible in A4D on different levels and it enables comparison of performance both between regions and between different suppliers and therefore, this KPI should be included in the dashboard. Figure 38 summarizes the previous findings regarding the OB delivery target fulfillment KPI.

Figure 38; Summary of the current status of the OB delivery target fulfillment KPI; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

OB Lead time – *see IB Lead time for purpose/importance of KPI.*

Lead time is measured within the GBO Outbound and the information is stored in its system called A4D. The data is measured on lane level but it is possible to aggregate the information up to PARMA and supplier group level.

Since accurate lead times are essential for the Outbound operations and since it gives an indication of the performance of the suppliers, it is a KPI that should be included in the dashboard. The lead time KPI should be a measurement of promised lead time versus actual lead time. The availability of data in A4D allows monthly updates of this information. Figure 39 summarizes the previous findings regarding the OB lead time KPI.

Figure 39; Summary of the current status of the OB lead time KPI; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

OB Arrival reporting and IB POD – Arrival reporting is an important requirement for the Outbound operations in order for them to be able to track the goods and also, to determine whether goods are delivered on time. Proof of Delivery (POD) is the equivalent within Inbound and it has similar importance within their operations as for Outbound. It is an importation administrative KPI that very well represents the quality of communication from the suppliers.

The point of arrival is reported by the carrier into A4D for Outbound and the system registers the level of performance regarding arrival reporting. Within Inbound there is not yet a global system in place that supports efficient measurements of POD but it is under development. Data is registered on all four levels; supplier group, PARMA, contract and lane level.

Arrival and departure reporting are very important administrative KPIs that are essential in order to keep operational efficiency within the GBOs. Compared to precision KPIs, the reporting measurements says nothing about the actual operational performance but still, it measures the supplier's ability to communicate which deserves specific consideration. Arrival and departure reporting is also a prerequisite for efficient precision measurements. Therefore, it is recommended to include the reporting measurements in the dashboard. Arrival reporting within Outbound allows monthly updates in a dashboard. Reporting quality will be the common denotation for the measurements arrival reporting/POD, departure reporting/POC (Proof of Collection) and the Inbound specific deviation reporting. Figure 40 and 41 summarize the previous findings regarding the OB arrival reporting and the IB POD KPIs respectively.

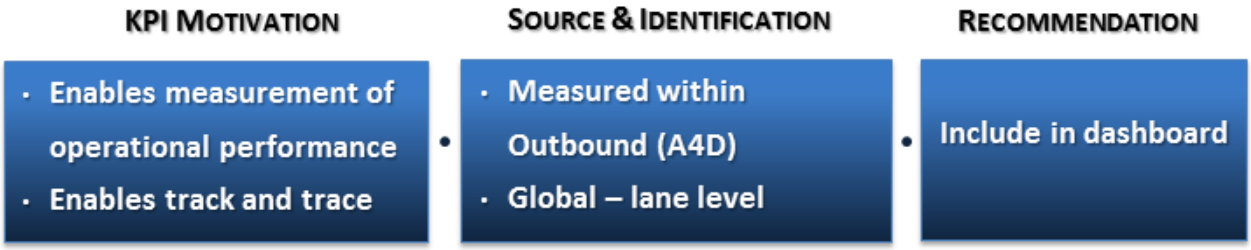


Figure 41; Summary of the current status of the OB arrival reporting KPI; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

Figure 40; Summary of the current status of the IB POD KPI; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

OB Departure reporting and IB POC – *see OB Arrival reporting/IB POD.*

ISO 9001 – Quality is one of the core values of the Volvo Group and VLC and an integral part of the company's operations. As the suppliers of VLC many times act as representatives of VLC towards the customers, the quality of the suppliers' operations is very important. Certification according to ISO 9001 means that the company has a quality focus in all of its processes. By certifying that the supplier works with quality, it means that less quality inspection is needed from the buying firm. Bad quality may imply considerable costs as a result of both, bad customer service, disruptions in supply and insufficient material quality in the products.

Information about the supplier's ISO certification is collected through the annual supplier survey and the data is stored in an excel sheet. Therefore, it is easily accessible for a supplier performance dashboard. A solution for the future is that the information about ISO certification is entered directly into the dashboard system instead of into an excel sheet.

Due to the considerable importance of high quality for the operations, products and services of VLC and because certification according to ISO 9001 is a fundamental requirement that VLC puts on its core suppliers, it should be included in the dashboard. The static characteristics of this measurement should not require more than annual updates about this information in the dashboard but of course, if a certificate expires, it needs to be updated. Figure 42 summarizes the previous findings regarding the ISO 9001 measurement.

Figure 42; Summary of the current status of the ISO 9001 measurement; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

ISO 14001/SmartWay – Environmental care is a subject that has attained increasing attention in recent years and it is also one of the core values of the Volvo Group. Certification according to ISO 14001 assures that the company has an environmental management system and works actively with questions that concern environmental care within its processes. Active environmental work may have several benefits for the single company and the entire supply chain; more efficient resource utilization, reduced amount of fossil fuels, goodwill in terms of credibility regarding environmental care etc. ISO 14001 has not been acknowledged in the US to the same extent as ISO 9001, and therefore, SmartWay is the equivalent to ISO 14001 for the North American operations.

Questions about certification according to ISO 14001/SmartWay are included in the annual supplier survey. The data is compiled and stored in an excel sheet. The information about expiring certificates is handled manually and reminders are sent by mail to concerned suppliers for them to update their certificates. The similar procedure applies for ISO 9001 as for ISO 14001/SmartWay.

Environmental awareness is essential for the operations within the Volvo Group and VLC and therefore, it is important that the environmental performance of the suppliers is satisfying. This measurement should be included in the dashboard due to its importance to the operations of VLC and because the information is easily accessible. The information can be updated annually, but potential future supplier self-reporting may allow updates whenever a certificate expires or is being renewed. Figure 43 summarizes the previous findings regarding the ISO 14001/SmartWay measurement.

Figure 43; Summary of the current status of the ISO 14001/SmartWay measurement; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

Average motor class – A large part of the discussion regarding *ISO 14001/SmartWay* applies to the motivation for measurement of average motor class. In recent years, more and more focus has been put on emissions of greenhouse gases and specific demands for reduction of CO_2 emissions. Transport by road is the mode besides air that accounts for the largest share of CO_2 emissions (Kungliga ingenjörsvetenskapsakademien, IVA, 2002). Since VLC does not own its own fleet of trucks, the company is indirectly responsible for the emissions of the suppliers it chooses. The type of engine in the trucks affects the rate of emissions and therefore, the average motor class can provide a approximate indication about the rate of emissions that is caused by a specific supplier, since actual rate of emission currently is a metric not possible to measure.

In the annual supplier survey, the suppliers are obliged to attach its fleet sheet to the answers it provides. From the fleet sheet, the Operational Excellence function calculates the supplier's average motor class. This information is compiled and stored in an excel sheet.

Average motor class gives a good indication of the rate of emissions that are caused by the suppliers and therefore, it should be included in the dashboard. It may be desired to have more precise measurements of the CO_2 emissions but due to the complexity of such calculations, an estimate through the motor class is sufficient considering the current conditions. Figure 44 summarizes the previous findings regarding the average motor class measurement.

Figure 44; Summary of the current status of the average motor class measurement; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

CO_2 emission, g/ton-km – *Purpose/Importance of KPI,* see *Average Motor class*

Operational Excellence has the ability to calculate an approximate figure of emission for different suppliers based on their fleet sheets. However, these figures are not always accurate as there are several factors that have an impact on the total rate of emissions.

As previously mentioned, it may be desired to have more precise figures on emissions than just average motor class. However, due to the inaccuracy in the CO_2 emission calculations and the inability to continuously track actual rate of emissions, figures on this KPI cannot be included in the dashboard. There are many ways to calculate emissions and most probably, the supplier will not always agree with the numbers presented by VLC since the parties may use different methods for calculation. Figure 45 summarizes the previous findings regarding the CO_2 emission KPI.

Figure 45; Summary of the current status of the CO2 emission KPI; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

Clean Shipping Index – Considering the increasing focus on environmental issues as described previously, it is equally important to monitor the emissions from sea transports as for transportation by road. To measure sea transport emissions, motor class is not applicable; instead, a large part of the sea transport suppliers report their emissions to the Clean Shipping Index. The Clean Shipping Index provides environmental information and a grade regarding the shipping company's vessels. The index is a representation of emissions of different environmentally hazardous substances, especially sulphur.

The clean shipping index information is reported by the sea carriers into an external website and data must therefore, be collected manually by VLC and entered into the dashboard system. Clean

shipping index concerns the European based sea carriers and not shippers based in other parts of the world. However, a majority of VLC's sea suppliers are based in Europe and the reporting covers all operations globally. The index is a representation of the sea carrier's emissions on a company group level.

Since consideration about environmental care within sea transports is becoming increasingly important, especially regarding sulphur emissions, the clean shipping index should be included in the dashboard. Since the Clean Shipping initiative is under development, it is only recommended to update these figures annually. This requires that an employee within VLC collects the information manually and transfer it into the dashboard. However, it should not demand too much time and resources. Figure 46 summarizes the previous findings regarding the Clean Shipping Index measurement.

Figure 46; Summary of the current status of the CO2 emission KPI; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

Contingency plan – To have a contingency plan for unforeseen circumstances and exceptional risks is very important. Especially for those suppliers that are the only provider of a specific product or service and where there is no additional alternatives for supply. The purpose with a contingency plan is to hedge against any disruptions that may be the result of a catastrophe and it is intended to mitigate the impact of a disaster.

Questions about a contingency plan are included in the RFI and the Supplier Survey. However, there is no consistent definition on what elements the contingency plan should include; each supplier may have its own standard and the results only give an indication whether the supplier has a plan or not. It does not provide any information on the quality of the contingency plan.

Considering the discussion in the previous paragraph, the metric contingency plan is not consistent enough to include in the dashboard. Nevertheless, as described in the first paragraph, it is an important parameter and it is recommended to try to enhance the consistency and ensure better quality of the measurement. A well-developed contingency plan is critical as it can mitigate the effects of disastrous scenarios that otherwise would cause severe supply disruptions. Figure 47 summarizes the previous findings regarding the Contingency plan measurement.

Figure 47; Summary of the current status of the Contingency plan measurement; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

Transport quality audit – In line with the core values safety and quality, VLC puts specific requirements on its suppliers to operate according to specific handling instructions. The intension with the transport quality audits is to ensure that the instructions are fulfilled so that the products, i.e. trucks, buses etc. are delivered under safe conditions. Poor performance in the transport quality audit may affect both delivery precision performance and damage rates and therefore, it is important to control and ensure that the handling instructions are fulfilled.

It is the responsibility of Risk Management to carry out transport quality audits. Based on the audit, the suppliers are ranked according to how well the handling instructions are fulfilled. The audits are only carried out in Europe and concerns road carriers. The data is measured on supplier group level and processed in the Risk Management System.

Since the transport quality audit metric is only applicable for road transports within the European operations and because there is a lack of consistency and all suppliers are not audited, the audit ranking should not be included in the dashboard. Nevertheless, transport quality audit is a tool to enhance supplier performance in collaboration with the supplier. Therefore, the dashboard may be useful in order to identify suppliers that are relevant for transport quality audits. Figure 48 summarizes the previous findings regarding the transport quality audit measurement.

Figure 48; Summary of the current status of the transport quality audit measurement; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

CSR Compliance – CSR related issues has attained more attention in society in recent years and are often debated in media. Along with the increasing attention, the customers are also putting higher demands on the suppliers to control the production conditions at each tier back in the supply chain. However, there is no consistent definition of what CSR is; the concept may represent many different aspects for instance labor conditions, environmental care etc.

In the RFI and the annual supplier survey, there are several questions that relate to CSR issues. By answering yes to the questions, agreement with AB Volvo's code of conduct for instance, the supplier is approved to meet the requirements of CSR compliance. As earlier mentioned, the survey is answered on a supplier group level and the results are stored in an excel sheet.

Since there is no consistent definition or industry standard of CSR compliancy, it is not recommended to include it in the dashboard at an initial stage. Currently, it does not provide sufficient information about how actively the supplier works with CSR and what the supplier actually accomplish through that work. A new standard for CSR with third party certification is under development and once this standard is accepted and used throughout the industry, this measurement should be included in the dashboard. Figure 49 summarizes the previous findings regarding the CSR compliance measurement.

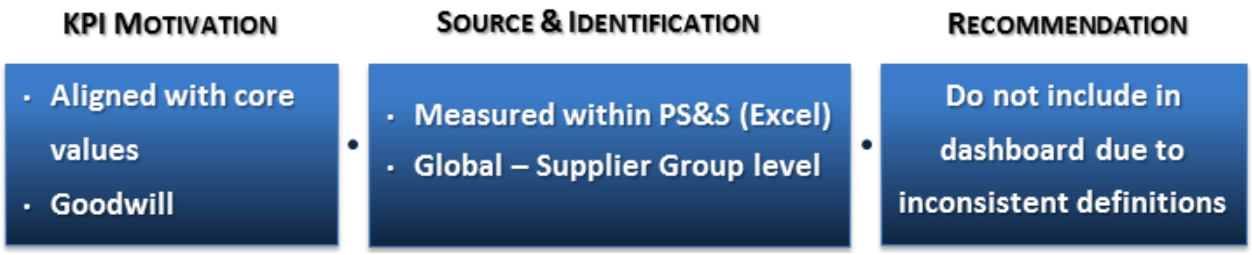


Figure 49; Summary of the current status of the CSR compliance measurement; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

Overall Risk – Overall risk represents the suppliers' attitude towards the four areas seatbelts, alcohol/drug policy, loading security and resting times. These are mainly CSR related issues that may have an impact on how AB Volvo is perceived by the customers and the society in general. It is important to be aware of the fact that the operations of the suppliers may affect the reputation of AB Volvo and therefore, it is relevant to measure how well the suppliers work with these issues.

The annual supplier survey includes questions about the areas covered by the measurement overall risk. Basically, questions are asked whether the suppliers actively work with these issues or not and the information is compiled in an excel sheet. Information in the supplier survey is collected on supplier group level.

Similar to the difficulties with CSR compliance, there is no consistent definition on what is actually required by the suppliers regarding these issues. It is also difficult to assess whether the suppliers perform sufficiently and VLC does very much rely in the yes or no answers in the survey. Therefore, this measurement is only considered to be a potential future measurement and is not robust enough to be included considering the current situation. Figure 50 summarizes the previous findings regarding the Overall risk measurement.

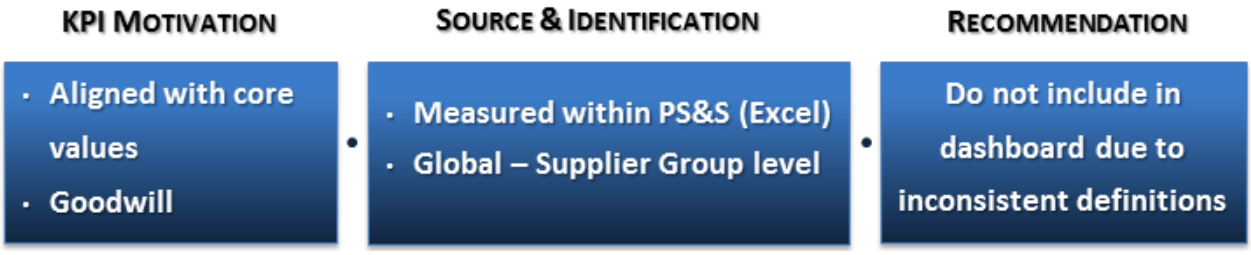


Figure 50; Summary of the current status of the overall risk measurement; why it is important and where it is currently stored. Also a judgment on whether it should be included in the dashboard or not is provided.

5.2.1 Ranking of KPIs

As a complement to the individual assessments in the previous part, this section will include a ranking of each KPI according to a number of different criteria. This ranking is based on the subjective perceptions of the authors and can be assessed differently by another evaluator. Nevertheless, the purpose of the ranking is to further evaluate the importance and usefulness of the metrics and motivate inclusion or exclusion in the supplier performance dashboard. The KPIs that were identified in the empirical chapter have each been given a grade from 1 to 3 in accordance with the rate of correspondence to different criteria. The numbers represents the following levels of correspondence:

1 = Poor compliance
2 = Good compliance
3 = Very good compliance

The different criteria that have been assessed are based on the criteria for performance indicators that were identified in chapter 3.3. The criteria *Be sensitive to changes within or outside the own organization* have been removed since it is considered to be more applicable for internal performance evaluation for the company's own operations, rather than evaluation of external parties. However, one criterion has also been added: *Be aligned with corporate strategy and objectives* as it was found in literature to be very important in the context of supplier assessment. The different criteria are presented in the list below:

1 = Be representative (global coverage)
2 = Be easy and simple to interpret
3 = Be capable of indicating trends over time
4 = Be easy to collect and process in terms of data
5 = Be easy and quick to update
6 = Be aligned with corporate strategy and objectives
7 = Be sensitive to changes within or outside the own organization

Table 18; Ranking of the KPIs that were identified in the empirical chapter. The rank range from 1 to 3 and assess six different criteria.

KPI	1	2	3	4	5	6	Total Score	Aver. Rank
IB/OB Transport Quality	3	2	3	3	3	3	17	2.8
IB/OB Transit time/Lead-time	2	1	3	2	2	3	13	2.2
IB Pick-up precision	1	2	3	2	2	3	13	2.2
IB Delivery precision (target fulfillment)	2	2	3	2	2	3	14	2.3
OB Delivery precision (target fulfillment)	2	2	3	2	2	3	14	2.3
Deviation Reporting	1	3	3	2	2	2	13	2.2
Arrival Reporting/POD	2	3	3	3	3	2	16	2.7
Departure Reporting/POC	2	3	3	3	3	2	16	2.7
Unloading precision	1	3	1	2	2	3	12	2.0
EMB Delivery Precision	-	-	-	-	-	-	N/A	N/A
Invoice quality	1	3	3	2	2	2	13	2.2
Financial Ranking	3	2	3	2	3	2	15	2.5
Spend	3	3	2	1	1	3	13	2.2
ISO 9001	3	3	2	2	2	3	15	2.5
ISO 14001/SmartWay	3	3	2	2	2	3	15	2.5
Average motor class	3	2	2	2	1	3	13	2.2
Clean Shipping Index	2	2	1	2	2	3	12	2.0
Contingency Plan	3	1	2	2	1	2	11	1.8
CO_2emissions, g/ton-km	2	1	2	1	1	3	10	1.7
Transport Quality Audit	1	3	2	1	1	2	10	1.7

The result of the ranking is illustrated in table 18. The total possible rank for one KPI is 18 points i.e. a rank 3 within each criterion. As the table shows, the KPI with the highest rank is transport quality; it gets almost maximum score except for the criterion interpretability. The lower number is explained by the fact that the KPI will probably be a representation of all incidents the supplier has been involved in during a certain period, both those the supplier is responsible for but also those where the supplier has no liability. This means that some ambiguousness may be created when interpreting the data.

Second best ranks are attained by the KPIs arrival and departure reporting; two KPIs that get the highest rank for all criteria expect the first and the sixths one. The reasons are that the KPIs are currently only measured within Outbound and not covering the operations of the remaining GBOs. Furthermore, arrival and departure reporting is more restricted to the efficiency of the daily operations at the GBO Outbound and do not provide sufficient information about the suppliers' actual performance regarding the physical transportations.

Financial ranking is also given a high score. Since the Financial ranking represents a number of different financial components, the figure may be more difficult to interpret and therefore, the KPI gets a lower score. Data collection requires some manual work and there is not a perfectly clear alignment with corporate strategy and the score is therefore two for these criteria. Spend has a

relatively low total figure. The main reasons are that the information collection requires a lot of manual work and it is not possible to update the information more frequently than semi-annually even if the figures change during that period of time.

Certification according to ISO 9001 and ISO 14001/SmartWay are ranked high. These are well aligned with the core values and the corporate strategy. However, data collection and information updates are currently requiring some manual work which explains the lower scores for those criteria. Average motor class gets a medium score; to produce the figure, extensive manual work is required and therefore, the score is low. The motor class metric is only representing an estimated average and therefore, the accuracy and interpretability is a bit lower.

A lower rank can be seen for the KPIs CO_2 emissions and Contingency plan. The primary reasons to the low numbers are the lack of consistency within both KPIs. CO_2 emissions are calculated based on motor class from the suppliers' fleet sheets. However, there are various additional factors that affect the rate of emissions which means that the accuracy and comparability of data between suppliers are limited. The figures are also requiring a lot of manual work to be produced and to be updated whereby low scores are achieved.

5.2.1 Summary of the assessment of potential KPIs

In the first column of table 19, there is a list of twelve KPIs and measurements that have been considered to be appropriate and most important to include in the supplier performance dashboard. Based on the previous evaluations, these measurements are labeled qualified as they are considered relevant and consistent enough to include in the dashboard. Due to system restrictions, a couple of the qualified measurements cannot be included instantly but should be included when the new systems LES and ATLAS are in place.

There are also four KPIs that is not included in the list of qualified KPIs but considered to be potential to include in the dashboard in the future. Therefore, they are included in the second column of table 18 which is labeled future. However, for different reasons that were presented in more detail in chapter 5.2, it is not recommended to include these four KPIs at an initial stage. In the third column of the table, KPIs that do not meet the criteria to be included in the dashboard are listed. These KPIs are measured within the VLC organization today but not considered to be relevant for the dashboard.

Table 19; KPIs and measurements categorized as qualified, future or non-applicable for the Supplier performance dashboard

QUALIFED	FUTURE	NON-APPLICABLE
Transport Quality	**CSR Compliance**	**Number of overdue invoices/total number of invoices**
Lead-time	**Overall Risk**	
Pick-up precision	**Contingency Plan**	
Delivery precision	**CO_2 emissions**	**Number of automatically matched CIC lines/total number of CIC lines**
Reporting Quality		
Financial Ranking		**Number of parked invoices/total number of invoices, defined according to labels**
Spend		
Invoice Quality		
ISO 9001		**Transport Quality Audit**
ISO 14001/SmartWay		**IB EMB Unloading precision**
Average motor class		
Clean Shipping Index		

5.3 Characteristics of KPIs

Based on the evaluations in chapter 5.1 and 5.2, the number of KPIs has been reduced. In table 19, there is a list of twelve KPIs that are labeled qualified and have been considered to be appropriate and most important to include in the supplier performance dashboard. There are also four KPIs that are labeled future. These measurements is not included in the list of qualified KPIs but considered to be potential to include in the dashboard in the future. In the third column of the table, KPIs that do not meet the criteria to be included in the dashboard are listed and these will not be further evaluated. These are labeled non-applicable in the table.

Van Weele (2010) presented four levels of supplier assessment; product, process, quality assurance system and company level. When categorizing the qualified KPIs and measurements among these four levels it is seen that they provide a diverse spread and covers all levels. The operational metrics of transport quality, lead-time, pick-up and delivery precision are all within the product level, providing information on how effective the suppliers provide their product; the transportation. Invoice quality, reporting quality, average motor class, Clean Shipping Index and ISO 14001/Smartway are all examples of measurements on a process level. The ISO 9001 is considered to be a measurement both on the process- and the quality assurance system level whilst financial ranking and spend is measured on a company level. The different levels and related measurements are presented in table 20.

Table 20; Distribution of the twelve measurements among the four levels of supplier assessment as presented by Van Weele (2010).

LEVEL	KPIS AND MEASUREMENTS
Product	Transport quality, lead time, pick-up precision, delivery precision
Process	Invoice quality, reporting Quality, Average Motor Class, Clean Shipping Index, ISO 14001/SmartWay, (ISO 9001)
Quality assurance system	ISO 9001
Company level	Financial Ranking, Spend

As table 21 below shows, there is no separation of operational KPIs between the different traffic lanes of Inbound, Outbound and Emballage. Instead, lead-time, delivery precision and reporting quality have been merged together for Inbound and Outbound in order to provide a simplified view. However, in the dashboard, the intension is to present the KPIs on precision for Inbound and Outbound separately due to the different characteristics in definitions. Important to be noted is that Reporting Quality refers to Deviation reporting and POD/POC at Inbound and Arrival- and departure reporting at Outbound. POD and POC would be included in the dashboard once the system, ATLAS that provides the measurement, is completely developed and implemented.

The purpose of this chapter is to evaluate the KPIs according to the different characteristics that were identified in the theory chapter 3.3. This means that each KPI is categorized as hard or soft, financial or non-financial and leading or lagging. This evaluation is conducted in order to investigate the balance of the KPIs in the dashboard. The KPIs have already been chosen but if an unbalance is detected, this is important information for VLC in order to be able to develop the content of the dashboard in the future.

Table 21; Categorizing the KPIs and measurements recommended for the dashboard

	KPI	Hard	Soft	Financial	Non-financial	Leading	Lagging
QUALIFIED	Transport Quality	X			X		X
	Lead-time	X			X		X
	Pick-up precision	X			X	X	X
	Delivery precision	X			X	X	X
	Reporting Quality	X			X	X	
	Financial Ranking	X		X		X	
	Spend	X		X			X
	Invoice Quality	X		X			X
	ISO 9001		X		X	X	
	ISO 14001/SmartWay		X		X	X	
	Average motor class	X			X	X	
	Clean Shipping Index	X			X	X	
FUTURE	CSR Compliance		X		X	X	
	Overall Risk		X		X	X	
	Contingency Plan		X		X	X	
	CO_2 emissions	X			X		X

Non-applicable KPIs: the remaining invoice KPIs, Transport Quality Audit & IB EMB Unloading precision

The first column of categories, hard or soft, displays a large number of hard measures within both the qualified and future KPIs, although there is a larger share of soft KPIs within the future KPIs. The hard measures are characterized by being derived from operational performance or financial results. The first category of qualified KPIs, denoted operational, are all traditional hard measures displaying the performance of the company's core activity of transportation and correlated measures. The second category is the financial KPIs, also traditional hard measures that are derived from financial reports and other financial-related departments, for example the I&CC department for the Invoicing Quality KPI.

The third category of qualified KPIs, core value, is on the other hand, not all seen as hard measures. The two management systems of ISO 9001 and ISO 14001/SmartWay provide a soft angle on measurements, as they are not derived from financial or operational reports. Looking at the KPIs that are possible to include in the dashboard in the future, there is an even split between hard and soft ones. This division and the larger share of soft measurements can be explained by the difficulty to collect and document soft KPIs in an efficient way. If it is possible to collect and process soft KPIs in a relatively easy and effective manner, the inclusion of more soft metrics in the dashboard will provide VLC with a more holistic picture of the supplier's performance in the aspect of hard and soft measures. One example in this context is a new standard for CSR that is under development. With an acknowledged standard, the conditions for accurate measurements will be improved and CSR Compliance can be included in the dashboard.

The metric CO_2 emission is a hard measurement. This metric would be highly recommended to include in the dashboard due to its strong alignment with corporate strategy. However, it is not possible to measure this in a correct and detailed way at the present point in time.

The division shown in table 21 with a higher number of hard than soft measures are expected as the dashboard focuses on the overall performance of the suppliers, including the three categories of operational, financial and core value KPIs. Operational and financial KPIs account for a large part of the total number of KPIs; these are traditional hard measures which also explain the division. The core value KPIs provide a more diverse perspective on the supplier's performance and are important to include. Since several of the future KPIs are categorized as core value with a soft character, it may allow for a more balanced dashboard in the future when these metrics are added.

The second column provides a categorization of financial and non-financial measurements and table 21 displays the division between the two categories. All KPIs besides the financial are categorized as non-financial; they are not possible to translate into monetary terms. All of the qualified financial KPIs are categorized as financial whilst none of the future potential KPIs are financial, hence all of these are categorized as non-financial.

The third and last column of leading or lagging KPIs provides a more differentiated division amongst the KPIs. The column includes some KPIs and measurements that have qualities that categorize them as being both leading and lagging. The difference between leading and lagging KPIs is that the lagging KPIs measures past performances whilst the leading KPIs predicts or drive future performances and also future economic results. The first two qualified core-value KPIs both provide information regarding how the supplier work with a specific set of questions, environmental aspects for ISO 14001, quality assurance for ISO 9001. These KPIs provide information relevant in order to avoid future problems, also characterizing them as leading KPIs. The suppliers of VLC may encounter situations in the future regarding environmental or quality issues. By being certified according to the ISO- or SmartWay standard, VLC is guaranteed that the supplier has a process in place to deal with the situation. The certification also ensures that standards are implemented in order to avoid these future situations.

The average motor class and Clean Shipping Index will provide insight into the supplier's future performance regarding emissions. If the KPI of CO_2-emission would be possible to monitor in a correct way this would be included in the dashboard on the expense of the average motor class KPI. The average motor class KPI is the best possible solution for including an emission related KPI for road transportations at the present. Clean Shipping is primarily included as an emission KPI but includes more information than only CO_2-emissions and would therefore be preferred. Whilst average motor class is a leading KPI, providing information on the future emissions, the CO_2-emission KPI in itself is measuring the actual outlet of emissions, hence being lagging.

Financial ranking is also categorized as a leading KPI, predicting future performance. As described in the empirical chapter, section 4.3.1, the financial ranking of VLC's suppliers represents the total risk for business failure of the supplier. With a high ranking, the financial performance of the supplier is predicted to be good without risk for business failure. A lower ranking on the other hand, predicts a higher level of risk for business failure, forcing VLC to take sufficient actions to ensure that the operations related to this specific supplier will not be affected in the future.

Transport quality and lead-time are both examples of lagging indicators providing information on how the supplier performed within the time period since the last update of the dashboard. The same is true regarding pick-up precision and delivery precision, these KPIs will display the number of transportations performed on time, either when picked-up or delivered, hence a lagging KPI. At the same time it is possible to argue that these two KPIs are leading since they provide information on how the supplier will perform within the lead-time KPI in the future, a high number on precision will drive the performance of the lead-time.

These KPIs are also driving the economic result of the operations. If the precision of the transports performed by the suppliers is high, this will lead to a high quality and high customer satisfaction leading to better economic results in the future. There are additional KPIs that may be relevant for this discussion of being both leading and lagging. For instance, the KPI CO_2 -emissions may also be categorized as leading since the rate of emissions drives the cost for fuel and eventually, the financial result. However, when discussing this further, several of the KPIs listed could be seen as driving the financial result in one way or another, and the discussion is therefore limited to the precision KPIs, driving both financial performance and the operational performance of the lead-time KPI.

The purpose of this chapter was to evaluate the balance between the KPIs that are included in the dashboard in order to ensure that all angles of measurements were included. As seen in the bar-chart in figure 51, there is a good spread of leading and lagging KPIs and also, between financial and non-financial measurements. However, there are more hard measures than soft, which is explained by the difficulty to measure soft metrics in an efficient way. Nevertheless, overall, the graph shows a good division amongst the different characteristics which means that the measurements in the dashboard provides a balanced view of the performance of the suppliers. It should be considered though, to try to include more of the soft measurements in the future.

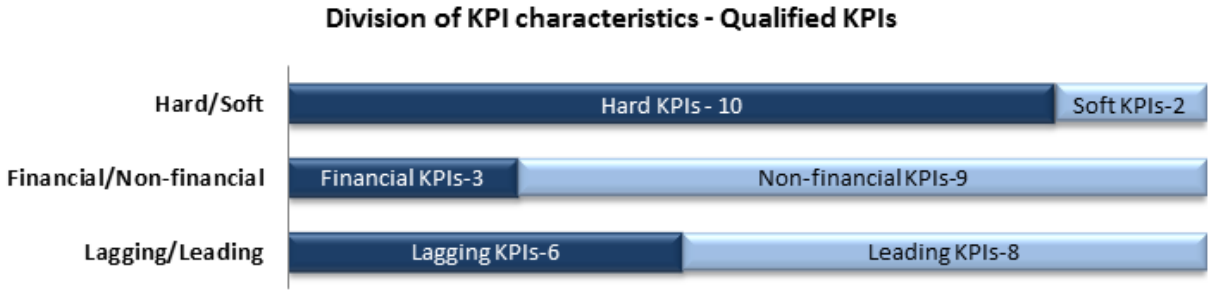


Figure 51; Bar chart displaying the spread of KPIs between the different characteristics.

5.4 Organizational representation of KPIs

The organizational aspects regarding which KPIs to include in the dashboard is another perspective to take into consideration in the analysis of the supplier performance dashboard and will be evaluated in this chapter. It is important to ensure that all departments that evaluate supplier performance are represented. There are seven different departments presented in the empirical chapter; Purchasing Strategy & Support (PS&S) representing the purchasing department, Inbound (IB), Outbound (OB), Emballage (EMB), Invoicing & Cost Control (I&CC), Operational Excellence (OE) and Risk Management (RM). These departments are all represented in table 22 where the division of KPIs amongst the departments is displayed.

Table 22; Illustration of the division amongst KPIs included in the dashboard between the departments at VLC.

***) Not possible to measure today due to system restrictions.**

KPI	PS&S	I&CC	OE	IB	OB	EMB	RM
Transport Quality				X	X		X
Lead-time				X*	X		
Pick-up precision				X*			
Delivery precision				X*	X	X*	
Reporting Quality				X*	X		
Financial Ranking	X						
Spend	X	X					
Invoice Quality		X					
ISO 9001			X				
ISO 14001/SmartWay			X				
Average motor class			X				
Clean Shipping Index			X				
Total	2	2	4	1/5*	4	1*	1

The purchasing department is represented in table 22 by the PS&S unit which includes the KPIs financial ranking and spend where the spend KPI is shared by both PS&S and the I&CC department. This is due to the fact that PS&S is currently carrying out the spend report manually twice a year but the intension is that it should be possible to gather this information on a monthly basis directly from the I&CC system where amounts invoiced per supplier is registered. The financial ranking is connected to PS&S with regards to execution, this is a KPI that permeates and effects the entire VLC organization. If a supplier is degraded to a lower score, this increases the risk for financial problems and ultimately closure. Such a risk involves all operations within VLC and execution of action plans due to the degrading may also affect some, or all, departments in their daily operations.

As mentioned, purchasing is only represented in the table by two KPIs. The majority of KPIs are connected to, and information is gathered from other departments within VLC. This is evidence for the need of a dashboard that displays information from the entire VLC organization. One purpose of the dashboard is to visualize the performance of a supplier. This purpose would have been able to fulfill even if all the KPIs already existed within the purchasing department. However, the second purpose of the dashboard is to gather information and the defragmented spread of KPIs in table 22 illustrates that the information needed for a holistic view of a supplier's performance is located at different departments within VLC. In order to ensure that decisions taken within the purchasing department is based on facts, this information needs to be collected and brought forward to the purchasing department, hence included in the dashboard.

The third financial KPI, besides Spend and Financial Ranking, is the Invoicing Quality measurement that is derived from the I&CC department. This KPI enables a discussion in the Supplier Management Forum regarding the troubles encountered within the administrative handling of the supplier's invoices. The Operational Excellence department is represented through four KPIs; the two ISO standards as well as Clean Shipping Index and Average Motor Class. These KPIs permeate the entire

VLC organization even though the responsibility lies with the Operational Excellence department. These KPIs are also closely aligned with the core values.

The three GBOs are represented in the table by the operational KPIs where both the Inbound and Outbound GBOs are represented by a number of KPIs. However, the Emballage GBO is only represented by one metric. This higher number for Inbound is connected to the higher level of complexity within the Inbound distribution leading to more measurements performed and needed. The measurements within Inbound are of outmost importance since deviations and disturbances in the delivery of components into the production facilities may result in large disruptions.

Several of the KPIs related to Inbound have been marked with an asterisk in table 22. These are KPIs that is recommended to include in the dashboard but will not be able to include initially due to system restrictions. The information regarding these KPIs would need to be collected from many different systems (TIR, FADS, and TPS etc.) as well as processed in order to merge the findings from the different systems together into each KPI. The Inbound organization is awaiting the roll-out of their new global system, ATLAS, which will create a holistic system environment where measurements are defined in a common way. This system implementation is a prerequisite for all operational Inbound KPIs to be included in the dashboard. In the meantime, until ATLAS is operative, these KPIs will have to be excluded from the dashboard.

Outbound does not operate with the same complexity, time constraints or time-windows as Inbound. Lead-time and delivery precision is though measured and included in both these GBOs whilst pick-up precision is only measured for Inbound. For Outbound the Reporting Quality KPI will include Arrival- and Departure Reporting, measurements that together with lead-time and Delivery precision can be collected from Outbound's system, A4D, hence no technical restrictions apply.

The Emballage GBO is only represented by one KPI that is marked with an asterisk in the dashboard. The reason behind the asterisk is that Emballage cannot measure delivery precision due to lack of system support within this GBO. The department has currently no system allowing them to perform measurements of the performance of the suppliers, making it impossible to include operational data to the dashboard. Hopefully, the implementation of the LES-project will enable also the Emballage GBO to carry out measurements in the future, hence be included in the supplier performance dashboard. This illustrates the importance of system support in order to be able to measure supplier performance.

The last department represented with KPIs in the dashboard is Risk Management and the KPI Transport Quality; a KPI that is also shared with Inbound and Outbound. Even if this KPI is managed by the Risk management department, it is a measure of the operational performance of the suppliers, hence connected to the two GBOs as well. This is a good example of a cross-functional KPI, important to several departments and therefore, it also provides a good foundation for discussion within the Supplier Management Forum. The quality of the transportations carried out by the suppliers and the number of damages reported per supplier is also closely aligned with the Volvo Group's core value quality.

The last core value of the Volvo Group; safety is not represented within this dashboard to the same extent as the other two of quality and environmental care. Safety can be perceived in different ways and for the end user of Volvo's products the safety is connected to the use of the products such as

construction equipment or buses etc. Safety is also connected to the production of the products and when it comes to the transportation of components and finished products safety can be linked to the future KPI of CSR compliance including labor and safety issues such as resting times and use of seatbelts.

5.5 Evaluation of KPIs and measurements per traffic mode

The KPIs and measurements for the dashboard also need to be evaluated depending on their fit towards the four different modes of traffic; road, rail, sea and air.

The KPIs are evaluated in table 23, where each KPI is matched towards the four traffic modes. This is done in order to highlight which KPIs are applicable for all traffic modes and which are traffic mode specific. Within the table, the KPIs are also evaluated on their geographical spread; whether the KPI is global or only applicable in certain regional areas.

Table 23; Evaluation of KPIs on fit towards traffic modes

KPI	IB Road	OB Road	IB Rail	OB Rail	IB Sea	OB Sea	IB Air	OB Air	Global
Transport Quality	X	X	X	N/A	X	X	X	N/A	X
Lead-time	-	X	-	N/A	-	X	-	N/A	X
Pick-up precision	-	N/A	-	N/A	-	N/A	-	N/A	-
Delivery precision	-	X	-	N/A	-	X	-	N/A	X
Reporting Quality	-	X	-	N/A	-	X	-	N/A	X
Financial Ranking	X	X	X	X	X	X	X	X	X
Spend	X	X	X	X	X	X	X	X	X
Invoice Quality	X	X	X	X	X	X	X	X	
ISO 9001	X	X	X	X	X	X	X	X	X
ISO 14001/SmartWay	X	X	X	X	X	X	X	X	X
Average motor class	X	X	N/A	N/A	N/A	N/A	N/A	N/A	X
Clean Shipping Index	N/A	N/A	N/A	N/A	X	X	N/A	N/A	X
Total	7	10	6	5	6	10	6	5	10

Table 23 shows that all the financial KPIs are applicable to each of the four traffic modes and that is also true for the core value KPIs consisting of ISO certifications. These KPIs are all general and not specific to any modes of traffic as well as possible to measure globally for all KPIs except the KPI of Invoice quality. Invoice quality is currently found in the I&CCs system CIC and is today, only applicable to Europe. However, the LES-project, introducing a new SAP-based solution for the I&CC department will enable this measurement on a global scale in the future.

The Spend KPI will also be influenced by the roll-out of the LES-project. Currently, the PS&S department collects and summarizes the spend data manually on a global scale twice a year. The I&CC department is able to retrieve the same information automatically from CIC on a monthly basis but only for Europe. This creates a debate on which way to go at an initial stage when creating the Supplier performance dashboard regarding the Spend KPI. If a global focus is the main objective, the information should be gathered twice a year from the Global spend report by the PS&S department. However, if a more frequent update is preferred, the information from I&CC and CIC should be used

where possible. Within a longer time horizon when the roll-out and implementation of the new system from the LES-project is finished, monthly updates globally will be enabled.

Among the core value KPIs, there are two that are specific to only one traffic mode; Average motor class and Clean Shipping Index. Even if these KPIs are specific they contain important information justifying their inclusion in the Supplier performance dashboard. Average motor class is only applicable for road transportations, but the close link between the motor class and emissions of greenhouse gases argues for the importance of the KPI. The road transportation is also the traffic mode with the largest number of active core suppliers. Together with the articulated environmental focus from Volvo, this KPI as well as the Clean Shipping Index for the sea transportations are justified in the dashboard.

When discussing if traffic mode specific KPIs should be included in the Supplier performance dashboard, it is defensible for the two modes mentioned above, road and sea. These two constitute 90 percent of the turnover for 2011. Among the 154 core suppliers, only two operate within rail traffic and there is no comprehensive summarizing environmental measurement for rail, as the Clean Shipping Index exists for sea that allows more close monitoring of emissions. Among the four different traffic modes, rail is also the one seen as most environmentally friendly. At an initial stage, it is therefore more important, and prioritized, to have close monitoring of emissions for the other traffic modes.

Among the four traffic modes air is the least environmentally friendly. This mode is primarily used for express transportations or transportation of high value goods. This means that there are no developed routes since most bookings are made under time constraint due to the urgent nature of the express transportation. There is no frame of reference for calculations, and the emission metric is not of same importance as for other fixed lanes in other traffic modes due to the express transportations.

The operational KPIs are more differentiated compared to the other categories. Within the operational KPIs, there is not only a division among the traffic modes but also a spread within the same traffic mode for the Inbound and Outbound flow of traffic. The KPIs evaluated and recommended to be included in the Supplier performance dashboard and displayed in table 23 should to as large extent as possible, be general and applicable to all suppliers. However, the KPI pick-up precision is only applicable to Inbound but it is seen as important to include anyway.

Within the Inbound flow, all the operational KPIs are applicable; however the current defragmented system environment does not support an automatic transferring of information into the dashboard at this point. The Inbound organization is awaiting the roll-out of their new global system, ATLAS, which will create a holistic system environment where measurements are defined in a common way and in the mean time until ATLAS is operative these KPIs will have to be excluded from the dashboard.

Within Outbound, the transportations are mainly carried out by road or sea transportation. With regards to the physical size and weight of the finished products; trucks, buses, construction equipment etc., air freight is not used. Neither is rail a transportation mode used and therefore, both of these are excluded in the table above, marked with Not Applicable (N/A). As mentioned above, one of the operational KPIs, pick-up precision is only measured within the Inbound flow and

therefore marked with N/A for Outbound as well. The remaining operational KPIs are all applicable to the Outbound flow and are also covering the VLC operations on a global scale. The Reporting Quality metric consists of arrival- and departure reporting for Outbound and together with delivery precision and lead-time they are applied to both road and sea transportations, although they are somewhat differently defined for the two traffic modes.

The last operational KPI, Transport Quality, measures the number of damages. It is applied to both Inbound and Outbound, although the measurement is carried out by the Risk Management department. This KPI is covering all products that are transported besides emballage which is included in the Inbound flow. Transport Quality is also measured on a global level through Risk Management's own system, RMS, creating the possibility for a holistic evaluation and also a comparison between Inbound and Outbound suppliers.

5.6 Summarizing discussion of KPI evaluation

In the chapters 5.1 to 5.5, the KPIs and measurements have been evaluated from several different perspectives. The analysis started with an assessment of the relevance of a supplier performance dashboard for the objectives of the purchasing function. It was found that the dashboard can be a supportive tool in many aspects while there are also weaknesses of the applicability which will be further discussed in chapter 5.6.1. It was also shown in 5.1 that the Supplier performance dashboard can fulfill several of the requirements on a dashboard that are desired by VLC. Particularly those requirements that relate to the Supplier Management Forum where suppliers will be assessed on an overall, supplier group level. If the dashboard shall be used also for decision making at lower, more detailed levels, it is required that the dashboard enable data drilldown and that puts specific requirements on the ability to connect and integrate the dashboard with many different systems for automatic data transferring.

The analysis ended up in twelve measurements that are recommended to be included in the dashboard. Due to system restrictions, a couple of these KPIs will not be possible to include at an initial stage but are recommended to be implemented when new systems are in place. Additional metrics were considered relevant and important to include but due to lack of consistent definitions, these should not be focused upon until later stages of the dashboard implementation. In chapter 7, more details regarding recommendations for the dashboard implementation process is presented.

It was shown in the first part of chapter 5.2 that system restrictions and lack of standard definitions were the primary reasons for not including some of the KPIs at the first stages of the dashboard implementation. The thorough evaluation of the KPIs was also complemented with a ranking of the KPIs in the second part of chapter 5.2. The ranking was completely based on the perception of the thesis authors and it might be judged differently by another evaluator. Nevertheless, the current rank can still give a rough picture of the appropriateness of the different KPIs and measurements, and the ranking is a good complement to the motivations to why KPIs should be included in the dashboard or not.

The twelve KPIs and measurements that were considered appropriate for dashboard inclusion were assesses based on their different characteristics; whether they were hard or soft, financial or non-financial and if they were leading or lagging. The findings are summarized in figure 52 where it is shown that the best mix was achieved between leading and lagging KPIs. The chosen set of KPIs does not include many soft measures. It can be explained by the difficulty to quantify soft metrics and generation of these metrics will most likely, require more manual work. Nevertheless, there are a couple of future KPIs that have a more soft character and these should be considered in a future context to achieve a more equal share of both hard and soft measures.

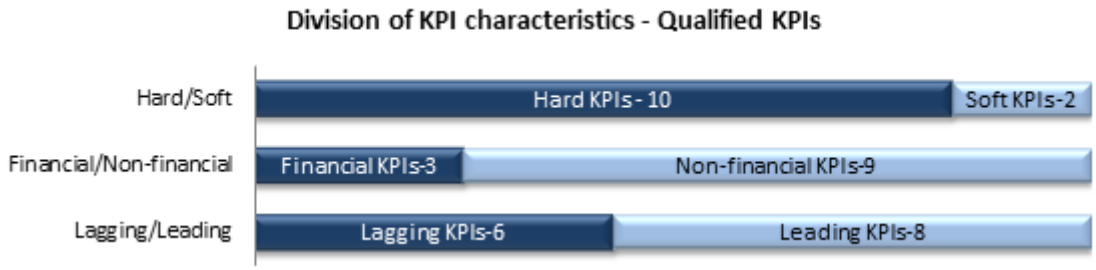


Figure 52; Illustration of the balance between different characteristics of the KPIs.

Something that has also been found from the analysis of the empirical data is that the purchasing function of VLC is the owner of only a few of the total set of KPIs and measurements that should be included in the dashboard. As figure 53 shows, there are seven different departments that each have an own interface to the suppliers. It shows that there is a decentralized supplier measurement structure. For different reasons it can be motivated to have several different interfaces in the company, especially as different departments have specific competencies.

At VLC, each department in figure 53 measures the suppliers based on what is relevant for their specific strategy and objectives. It means that each of these departments is responsible for a couple of supplier KPIs. However, it also results in information disparity that is the root cause for the need of a supplier performance dashboard at the purchasing department; a dashboard where the most relevant information from disparate systems are compiled to provide a comprehensive view of the overall supplier performance.

Figure 53; Illustration of the decentralized supplier measurement structure at VLC where several departments are responsible for different measurements.

Finally, the KPIs were also evaluated based on their generalizability and applicability to different traffic modes. It is desired that the dashboard should be relatively general and not too situation specific. It was found that many of the KPIs cover all traffic modes but there are also those that are

specific to only road and sea. Furthermore, since the outbound operations only concerns transportation by road or sea, the related operational KPIs will only be relevant for these modes and not applicable for air or rail transports for example.

As a concluding picture to illustrate the current state and conditions regarding the supplier measurement structure at VLC, a mind map is provided in figure 54. The mind map shows a complex reality where there are different prerequisites and conditions for the different measurements. It is important to highlight this view, since it shows the difficulty with the creation of one common location where all the important information is instantly accessible when needed.

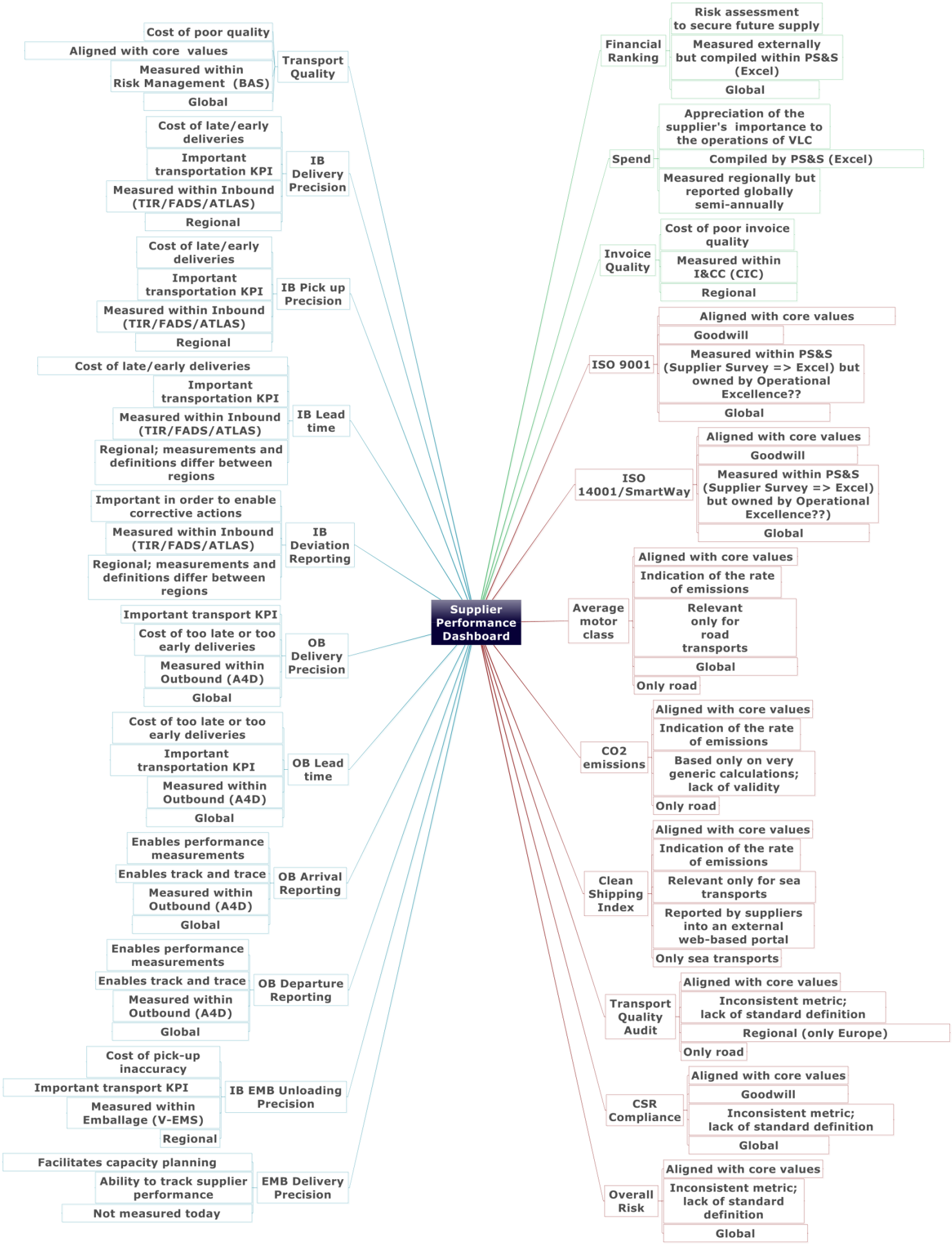


Figure 54; Mind map that covers all the measurements that were found from the empirical study. It shows the different prerequisites and conditions that are related to each of the KPIs.

5.6.1 Critical discussion about the dashboard

It was found in the literature review, that enterprise dashboards can be a supportive tool for more efficient information processing and decision making. However, it is important to consider the fact that the content in a dashboard is a simplification of a much more complex reality. The mind map in figure 54 in the previous section gives an indication of this complexity, even if this can also be seen as a rough simplification of what the reality looks like. The complexity that is shown in the mind map is the result of different supplier measurements that are carried out within different departments of VLC where varying conditions for measurements exist. It is not an easy task to translate this complex reality into a simple dashboard without a part of the information being left out. This is something that needs to be considered when creating a dashboard; selection or exclusion of any KPI or measurement will affect what kind of information the user gets access to and what data will be the basis for the decisions making.

This aspect was considered when deciding what KPIs and measurements that should be recommended to be included in the Supplier performance dashboard at VLC. After thorough evaluation of the KPIs that were identified in the empirical study, the list was reduced resulting in a set of KPIs and measurements that are recommended to be included in the dashboard. This means that a couple of KPIs have been excluded from the dashboard. Some of the KPIs were excluded because they were not relevant for supplier assessment, however, it can be concluded that the main reasons for exclusion are technical restrictions and lack of standard definition of KPIs. Those KPIs and measurements that are not possible to include due to these reasons are still relevant and can provide important information that should also be considered when making decisions even if they are not seen in the dashboard. Furthermore, it is recommended that the technical solution enables data drilldown and linkages to more detailed reports in order for the decision maker to find the root causes of any deficient performance.

In this context, it is also important to discuss whether a Supplier performance dashboard is what purchasing at VLC really needs and if it is the right solution to its issues to compile relevant supplier data. It was found in section 5.1 that a dashboard can support the fulfillment of some of the objectives of the purchasing function that were found in theory. However, the dashboard cannot reflect the relationship between VLC and its supplier; the possession of power, ease of communication, etc. Furthermore, since there are many departments and actors that interact with the supplier, it is difficult to grasp how well the relationship and communication works within each department since the conditions for communication may differ.

There are additional tools with other features that can be seen as alternatives to a dashboard. The Balanced scorecard for instance, ensures a balanced view of different metrics that are grouped into four categories. In comparison, it is not certain that the dashboard can give this balanced view; it depends of course on what metrics are included. It was shown in the analysis that the chosen set of twelve KPIs are a good mix between financial and nonfinancial metrics as well as both leading and lagging KPIs. However, there is an imbalance between hard and soft measures and that is something that is important that VLC and the user of the dashboard are aware of. Furthermore, the balanced scorecard includes a ranking of the level of performance that is achieved for each KPI which may facilitate the comparison of performance between different measurement objects. An additional tool to be used instead of a dashboard is different types of surveys where it might be possible to grasp and measure more soft measures. Nevertheless, none of these alternatives can provide the

visualization that the dashboard provides and it can be difficult, especially from a survey, to get a holistic view.

Another thing that is important to consider, is how the suppliers perceive the application of a supplier performance dashboard. Supplier assessment can be seen as a way of ensuring high quality of purchased products or services as high quality is considered important and prioritized by the buying firm. However, there might be a risk that supplier measurements and control also send a signal of distrust. It is not certain that the deployment of a dashboard is received positively by all suppliers; some may perceive it as VLC is not relying on their operations.

Furthermore, it can also be considered to be wasteful if some metrics are measured doubly, both by the buyer and the supplier. Nevertheless, in this specific case of the deployment of a supplier performance dashboard, the intension is that the dashboard should be a tool to detect deviations and deficient performance that can be improved through collaboration with the supplier and common actions. It is also something that is supported by theory (Gordon, 2005), that the next steps after deploying a supplier performance assessment system is to give feedback to suppliers on their performance and then produce results in terms of improvements from measuring supplier performance. It was also shown from the interviews with the suppliers that the attitude towards a supplier performance dashboard was nothing but positive although one supplier mentioned that they did not wished to be measured on something that was not agreed upon and included in the contracts.

To conclude, the previous discussion in this section has described some of the weaknesses of the dashboard and important issues to be aware of. Nevertheless, the conviction of the usefulness of a supplier performance dashboard to track supplier performance has not been reduced. Considering the situation at the purchasing department of VLC today where only a minor part of the supplier performance data is accessible, a dashboard will be a step in the right direction towards enhanced availability to relevant information and it also creates ability to base decisions on facts instead of gut feeling.

The purpose of a dashboard is of course not to be only a sufficient solution that is perceived as better than nothing, however, due to the complexity of the creation of a dashboard and the disperse structure of measurement systems and levels of identification, the implementation must start in a smaller scale where not all information is included initially. Additional KPIs will then be added step by step and therefore, it is also important to find a solution that is sustainable and that is possible to continue to build on in the long term.

5.7 Evaluation of systems and technical solutions

When creating a dashboard, one of the prerequisites is that the data can be automatically feed into the system, otherwise the dashboard will require too many resources (Rasmussen, et al., 2009). This requirement has also been emphasized by VLC; if the dashboard demands too much manual work it will be too complex and costly to develop and the project will most likely not be realized. Therefore, it must be possible to integrate the dashboard system with the existing systems at VLC.

As seen in table 24, there is a complex reality regarding systems and identification of information that needs to be considered when initializing the concretization of the Supplier performance

dashboard. Regardless of technical solution chosen for the concretization, this complex structure will have to be managed.

This complex reality is most likely one of the reasons why a tool such as the dashboard, solving the problems of dispersed information, have not been created previously within VLC although the need for such a tool has been identified. However, since this thesis has identified systems that will have to be integrated with the Supplier performance dashboard as well as levels of identification of information, VLC now possesses a roadmap that can guide the technical implementation of the dashboard.

Table 24; Current and future system and level of identification for all recommended dashboard measurements

KPIs and measurements	System (Current)	System (Future)	Identification (current)	Identification (future)
Transport Quality	**RMS**	**RMS**	**Contract**	**Contract**
IB Pick-up precision	**TIR/FADS/ATLAS**	**ATLAS**	**N/A**	**Contract***
IB Delivery precision	**TIR/FADS/ATLAS**	**ATLAS**	**N/A**	**Contract***
OB Delivery precision	**A4D**	**A4D**	**Lane**	**Lane**
EMB Delivery precision	**N/A**	**LES**	**N/A**	**PARMA***
IB Lead time	**TIR/FADS/ATLAS**	**ATLAS**	**N/A**	**Contract***
OB Lead time	**A4D**	**A4D**	**Lane**	**Lane**
IB Deviation Reporting	**TIR/FADS/ATLAS**	**ATLAS**	**N/A**	**Contract***
IB POD	**TIR/FADS/ATLAS**	**ATLAS**	**N/A**	**Contract***
IB POC	**TIR/FADS/ATLAS**	**ATLAS**	**N/A**	**Contract***
OB Arrival Reporting	**A4D**	**A4D**	**Lane**	**Lane**
OB Departure Reporting	**A4D**	**A4D**	**Lane**	**Lane**
Financial Ranking	**Excel**	**Excel**	**Supplier Group**	**Supplier Group**
Spend	**Excel**	**LES**	**PARMA**	**Contract***
Invoice Quality	**CIC**	**LES**	**PARMA**	**Contract***
ISO 9001	**Excel**	**Excel**	**Supplier Group**	**Supplier Group**
ISO 14001/SmartWay	**Excel**	**Excel**	**Supplier Group**	**Supplier Group**
Average motor class	**Excel**	**Excel**	**Supplier Group**	**Supplier Group**
Clean Shipping Index	**Excel**	**Excel**	**Supplier Group**	**Supplier Group**

The identification of information is a more critical obstacle to overcome than the complex system environment. If the quality of gathering the correct data per core supplier, by aggregating measurements from different lanes/contracts/PARMA-ID up to the supplier group level cannot be secured, integration between the dashboard and different VLC systems is useless. This since the dashboard will not receive quality proof input and therefore, not display accurate information. In order to ensure that the input is accurate, each core supplier that will be included in the dashboard needs to be investigated.

The investigation should map each supplier within each of the four levels, presented in figure 55, starting with securing which PARMA-ID that is connected to the Supplier Group name. It is also important to control that the same PARMA-ID for the same supplier is used throughout the entire organization. This will have to be investigated since observations during the case study have

indicated that so may not always be the case. Thereafter the investigation should map which contracts are connected to each PARMA-ID and consequently, which lanes are connected to the different contracts. How deep down the investigation is needed depends on which level the measurements intended for this specific supplier are measured.

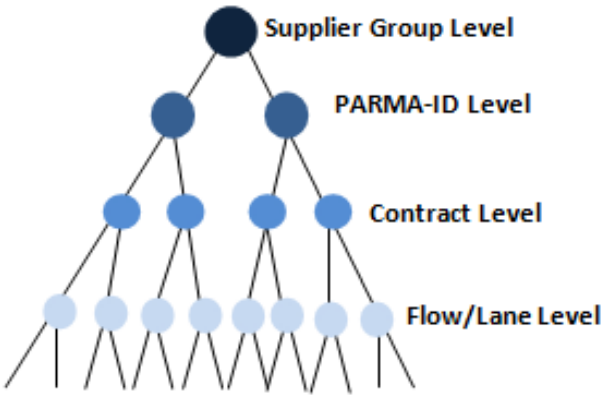


Figure 55; Illustration of the four levels of information identification.

5.7.1 Visualization of KPIs

In this chapter, a suggestion regarding the visualization of the qualified KPIs will be presented. It should be possible to track all KPIs and measurements over time and create trends over a rolling twelve months at the least should be displayed for KPIs updated on a monthly basis. If there are less frequent updates, a longer rolling period should be considered. An example of the visualization is shown in figure 56 on the next page.

It is not within the scope of this thesis to recommend a technical solution to the dashboard and VLC but to provide different requirements for VLC to take into consideration when choosing a future system. Examples of such requirements are the visualization of the KPIs that are presented in figure 56.

Two technical systems have been briefly examined as possible future solutions for the dashboard. The first system is provided by Ariba which is a company that VLC already collaborates with. Within purchasing there is currently a pilot project for implementing a contract module into VeSA from Ariba and it is also possible to add a supplier performance module within the Ariba concept. The second potential system is QlikView that is provided by QlikTech which is a fast growing company that was invented in Sweden. QlikView is specialized in BI and dashboard solutions. In a report by the Aberdeen Group (2010), indications showed that QlikView was able to deliver dashboard solutions at a lower cost compared to the top performers and still achieving successful results.

As mentioned in the delimitations, no detailed evaluation of dashboard systems is within the scope of this thesis. However, it is worth to be mentioned, that both systems Ariba and QlikView offer trials where the buyer only pays for the work of the consultant. Through a small pilot project it can be possible to investigate whether the system suits the need of VLC or not.

Figure 56; Visualization of the recommended KPIs and measurements for the Supplier performance dashboard.

5.8 Implementation process

There are a number of factors and prerequisites that need to be ensured before the implementation process of the Supplier performance dashboard and related KPIs and measurements can be initiated. The identification of information per core supplier needs to be updated; meaning that the contracts and the PARMA-IDs used for each supplier needs to be controlled. This is done in order to make sure that all information and essentially the correct information are collected per supplier for display in the Supplier performance dashboard.

The target level per supplier for the different KPIs also needs to be decided upon. A large amount of information can be collected through the contracts but discussions involving the responsible purchasers and employees from the responsible department of the metrics may also be necessary in order to determine levels of target or target fulfillment per supplier.

The implementation process that is displayed in figure 57 below is divided into five steps. This process contains no time horizon that states how long each step should last but should be viewed as an incremental process where each step is followed by the next. Some of the steps require more input than others resulting in longer time needed for fulfillment. Some of the steps also need the implementation of different IT systems to be launched for the KPI implementation to be possible, which then will involve different start dates depending on the roll-out of these systems. These systems are ATLAS for the operational metrics regarding Inbound and LES for the operational metric for Emballage and a monthly and manual update of Spend as well as the Invoice quality KPI.

The first process step includes the metrics measured within PS&S and Operational Excellence and embraces all core value related metrics. These are metrics stored within different excel solutions; hence integration between the dashboard and these solutions is necessary. Within the second process step integration towards A4D and RMS is required in order to include all operational metrics for Outbound as well as the Transport Quality KPI for Outbound and Inbound as well. The following two process steps are dependent upon the roll-outs of LES and ATLAS. The roll-out of LES will precede ATLAS and is therefore staged in process step number three, followed by the ATLAS related metrics in process step four. Once process step four is completed, all metrics recommended to be included in the dashboard will have been implemented. Process step five contains the KPIs and metrics categorized as future KPIs, and should be implemented into the dashboard once they have matured and fulfill requirements ensuring the quality of the metrics.

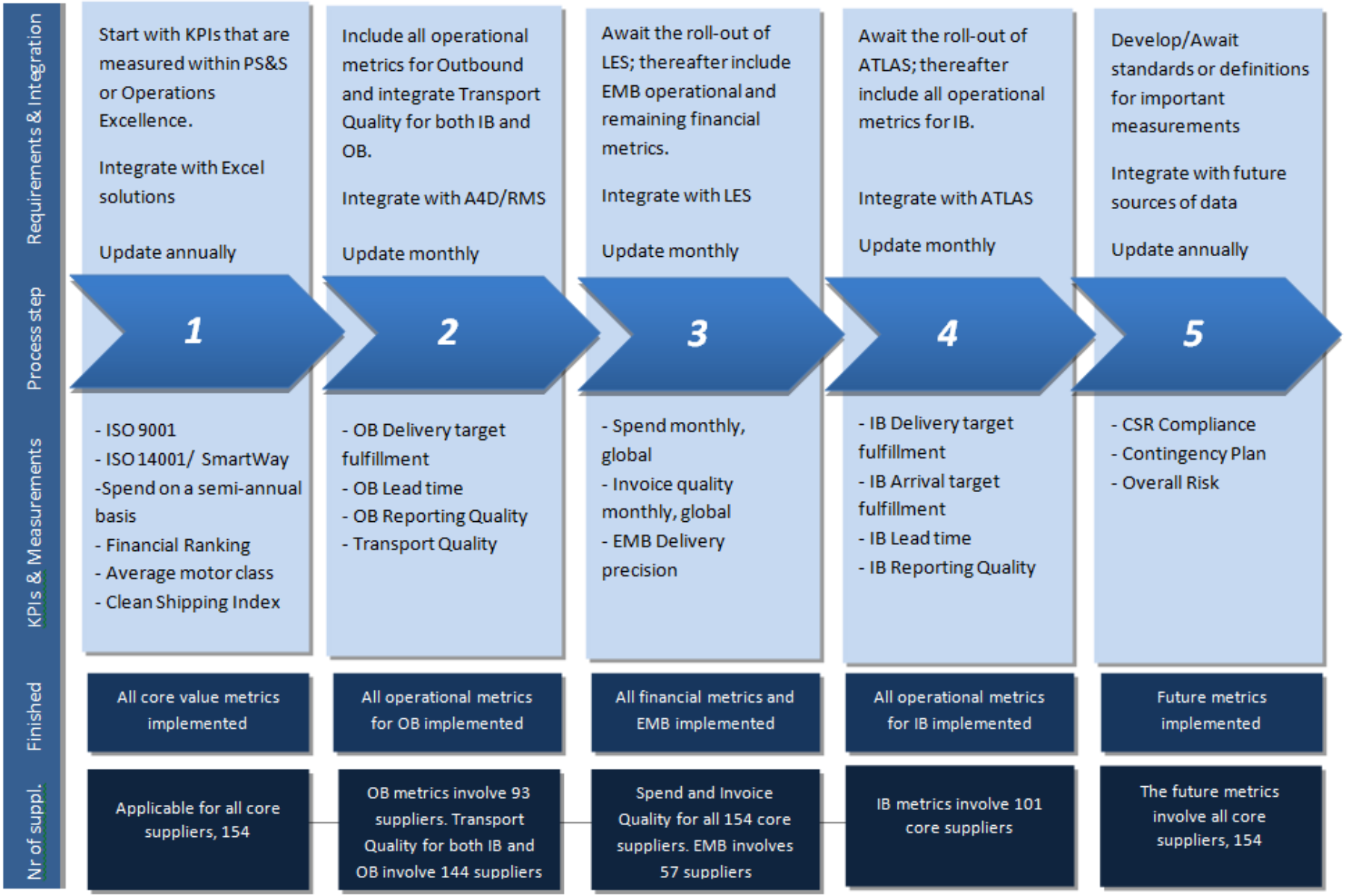


Figure 57; Implementation process for the supplier performance dashboard

6 Conclusions

This chapter contains conclusions that answer the three research questions that were presented in the introductory chapter. The questions are presented separately and each section includes relevant information to answer the questions.

1. *How is the supplier performance evaluation process currently performed at VLC?*

Currently, there are seven different departments within the VLC organization that carry out supplier performance evaluation through different measurements and KPIs. These seven departments are displayed in figure 58. The metrics that are measured differ depending on the strategy and objectives of the specific department and there are no departments that measure exactly the same thing since each department focuses on what is most important for their operations. Even though the operational KPIs related to the GBOs share the same denotations, they are still considered to be separate types of measurements since the operations within the GBOs differ substantially between each other. It was found that the GBOs and Risk Management focus on operational measurements, the I&CC department measures financial measurements while the PS&S department and Operational Excellence share the core value related measurements. PS&S is also measuring a couple of financial metrics.

Figure 58 also provides a visualization of the decentralized organization around the supplier performance evaluation process, which includes several interaction points between VLC and the supplier. Several of the points of interaction in this structure do have its own forum for evaluation which is needed for supplier assessment on a more detailed level. One such example is the operational transportation meetings that are conducted with the suppliers on a regular basis within both Inbound and Outbound. Nevertheless, there is no forum that deals with the overall supplier performance. Hence, the Supplier Management Forum that has been initiated by PS&S will provide a solution to this problem.

The decentralized supplier evaluation process at VLC makes it more difficult to get access to, and collect relevant supplier data and there is a lack of a holistic view of the overall supplier performance. The mind map in figure 54 provides an illustration of the complex structure of different supplier measurements that are carried out within VLC. This is particularly problematic for the purchasing function since it is its objective to assess supplier performance in order to make correct purchasing decisions that are based on accurate facts and that enable collaboration with only the best performing suppliers in the market.

Figure 58; Illustration of the complex supplier evaluation process with several contact points between VLC and the supplier

2. *What performance indicators should be included in the supplier performance dashboard?*

In the end of chapter 5.2, a list of the KPIs and performance indicators that are recommended to be included in the supplier performance dashboard is presented. This recommendation is based on a thorough evaluation of all the metrics that are currently measured within the VLC organization. This evaluation is included in the analysis chapter and is based on the following perspectives; characteristics of KPIs, accessibility of measurement information, relevance and generalizability of metrics and key user requirements. It is recommended to include the KPIs and measurements into the dashboard in a stage process. The twelve metrics are categorized as operational, financial or core value related and are presented in table 25 below:

Table 25; Recommended KPIs and measurements for the dashboard.

Operational	Financial	Core Value
Transport Quality	**Invoice Quality**	**ISO 9001**
Delivery Precision	**Spend**	**ISO 14001/SmartWay**
Pick-up Precision	**Financial Ranking**	**Average Motor Class**
Lead-time		**Clean Shipping Index**
Reporting Quality		

These twelve measurements will be sequentially implemented in the dashboard since system restrictions will hinder the implementation of all metrics instantaneously. Implementation through different stages is also beneficial since the dashboard itself can be tested and evaluated throughout the implementation process. Sequential implementation allows for quality assurance of the implemented data. It is then possible to detect potential inconsistencies and inaccurate measurements that can be adjusted in order to ensure that the measurements and the information about the suppliers that are included have been tested. This will enhance the dashboard and ensure that it becomes an useful and reliable tool.

The initial recommended twelve measurements might be complemented with additional measurements in the future by metrics that are categorized as future KPIs in this thesis. However, this will require improvement work to enhance the quality of potential measurements, since inconsistency in the metrics occur and the quality of the measurements cannot be ensured under the current conditions. Therefore, some measurements require further development work to enhance the quality of the metrics before they can be considered reliable and useful enough to be included in the supplier performance dashboard.

3a. Where is the information relevant for the Supplier performance dashboard stored?

The information presented in table 26 was compiled in chapter 5.7. It illustrates in which system different KPIs and results of different measurements are stored, both today and also in the future when new systems that are currently under development or are going to be implemented, are in use.

Table 26; Systems, both currently and future, where KPIs and measurements for the Supplier performance dashboard is found

KPI/Measurement	System (Current)	System (Future)
Transport Quality	**RMS**	**RMS**
IB Pick-up precision	**TIR/FADS/ATLAS**	**ATLAS**
IB Delivery precision	**TIR/FADS/ATLAS**	**ATLAS**
OB Delivery precision	**A4D**	**A4D**
EMB Delivery precision	**N/A**	**LES**
IB Lead time	**TIR/FADS/ATLAS**	**ATLAS**
OB Lead time	**A4D**	**A4D**
IB Deviation Reporting	**TIR/FADS/ATLAS**	**ATLAS**
IB POD	**TIR/FADS/ATLAS**	**ATLAS**
IB POC	**TIR/FADS/ATLAS**	**ATLAS**
OB Arrival Reporting	**A4D**	**A4D**
OB Departure Reporting	**A4D**	**A4D**
Financial Ranking	**Excel**	**Excel**
Spend	**Excel**	**LES**
Invoice Quality	**CIC**	**LES**
ISO 9001	**Excel**	**Excel**
ISO 14001/SmartWay	**Excel**	**Excel**
Average motor class	**Excel**	**Excel**
Clean Shipping Index	**Excel**	**Excel**

Table 26 provides insight into the complex and decentralized system environment within the VLC organization regarding measurements for supplier assessment. This complex system environment leads to an increased need for integration between the different systems and the supplier performance dashboard. This needs to be taken into consideration when choosing the technical solution for realizing the dashboard and also, when creating the time plan for its implementation.

3b. How can the information relevant for the Supplier performance dashboard be identified?

In the empirical chapter, chapter 4, the information regarding the level of identification for each measurement included into the supplier performance dashboard is found. This information is summarized and displayed in table 27 below.

Table 27; Current and future level of identification of each KPI and measurement included in the Supplier performance dashboard

KPI/Measurement	Identification (current)	Identification (future)
Transport Quality	**Contract**	**Contract**
IB Pick-up precision	**N/A**	**Contract***
IB Delivery precision	**N/A**	**Contract***
OB Delivery precision	**Lane**	**Lane**
EMB Delivery precision	**N/A**	**PARMA***
IB Lead time	**N/A**	**Contract***
OB Lead time	**Lane**	**Lane**
IB Deviation Reporting	**N/A**	**Contract***
IB POD	**N/A**	**Contract***
IB POC	**N/A**	**Contract***
OB Arrival Reporting	**Lane**	**Lane**
OB Departure Reporting	**Lane**	**Lane**
Financial Ranking	**Supplier Group**	**Supplier Group**
Spend	**PARMA**	**Contract***
Invoice Quality	**PARMA**	**Contract***
ISO 9001	**Supplier Group**	**Supplier Group**
ISO 14001/SmartWay	**Supplier Group**	**Supplier Group**
Average motor class	**Supplier Group**	**Supplier Group**
Clean Shipping Index	**Supplier Group**	**Supplier Group**

As stated earlier, some measurements recommended to be included in the dashboard cannot be implemented at an initial stage due to system restrictions and therefore, these are labeled N/A in table 27. These measurements and the KPIs Spend and Invoice Quality, are denoted with an asterisk at the level of identification in a future context. These measurements are all awaiting the roll-out of either ATLAS or LES, and contract is the level of identification proposed. However, it is not fully decided upon and it may be subjected to changes.

As the metrics are measured on numerous different levels of identification, it is important to ensure the quality of the data when it needs to be aggregated up to supplier group level, which is the initial focus of the dashboard. In order to guarantee this, target fulfillment will have to be used when information regarding performance within different lanes and contracts are going to be merged.

7 Recommendations

In this section, the recommendations to VLC regarding the implementation of a supplier performance dashboard are provided. The section is divided into three parts with different time perspectives; recommendations before dashboard implementation, recommendations on a short term during implementation and recommendations on a longer term. The chapter also includes some general recommendations that need to be considered in conjunction with the dashboard project.

Pre-implementation phase

- **Set required levels of target fulfillment –** Set the required levels of performance for each measurement so that the dashboard has points of reference to measure against.
  - ✓ Since the dashboard will measure on a global scale, aggregating operations within different regions with different performance levels, it is important to use target fulfillment and as an overall measurement.
- **Revise the PARMA system** – During the study, it was found that the supplier identification system contains some inconsistency. There are examples of suppliers that have different PARMA-IDs in different systems and in order to ensure data accuracy and fair supplier evaluation, the system for supplier identification need to be revised.
- **Decide upon dashboard system –** Two suggestions on dashboard systems have been provided in this thesis. A majority of system providers offer trial versions or pilot projects for customer evaluation. It is recommended to start with the set of KPIs that are accessible within the purchasing department and run a pilot test including around ten core suppliers.
  - ✓ The dashboard should not only gather and provide the purchasing department with information but also display and visualize the information in an easy and accessible way. This puts specific requirements on the technical solution that will be the final choice for realization of the supplier performance dashboard. For examples of visualization of selected KPIs see chapter 5.7.1.
- **Create a project team –** Create a project team that will have specific focus on the dashboard implementation. This project team should preferably be managed by a representative from the PS&S department. The project team will be of a dynamic nature where the participants will change as the project proceeds depending on which stage in the implementation process the project has reached. The project group should preferably involve representatives of the department that performs the specific measurements.

Implementation – Short term

- **Introduce the first implementation step –** Start with the implementation of the measurements that are automatically accessible within the purchasing department. The dashboard will then include; ISO 9001, ISO 14001, Average motor class, Clean Shipping Index, Spend and Financial ranking and these measurements will have a global coverage. Clean shipping index will require manual data transferring and as mentioned previously, it is only relevant for European carriers but it covers their operations globally. Spend will have a global coverage but can only be updated semi-annually until LES is implemented.
- **Introduce the second implementation step –** Initiate a project for system integration to transfer data from A4D and RMS. The Outbound related operational metrics will then be included in the dashboard as well as the transport quality KPIs for both Inbound and Outbound.

Implementation – Long term

- **Introduce the third implementation step; Await LES roll-out** – It is recommended to await the implementation of LES before including additional KPIs. To facilitate the dashboard project planning, it is good to continuously communicate with the LES-project to track when parts of the system will be implemented and new functionalities will be in place. When new functionalities are in place which will allow for extraction of invoice quality, spend and Emballage related operational data, a new project for data integration can be initiated to also include these measurements in the supplier performance dashboard.
  - ✓ Invoice quality for the European operations is currently accessible in another system but due to limited coverage and to avoid rework, it is recommended to await inclusion of invoice quality until the LES-project is completed.
  - ✓ Emballage related operational KPIs only include delivery precision. Since more details about the Emballage related measurements were not in place during the execution of this thesis, it is important to evaluate further details about this measurement.
- **Introduce the fourth implementation step; Await ATLAS roll-out –** The Inbound related operational KPIs cannot be added to the dashboard until ATLAS is implemented.
  - ✓ The ATLAS system will be implemented in stages which mean that a global coverage of measurements cannot be achieved instantly. The first ATLAS roll-out will include road Europe and then additional regions and modes can be added. The recommendation is to add the Inbound measurements in stages.
  - ✓ Communicate with the ATLAS project to make sure that the functionalities required from a purchasing perspective is also included in order to make the best use of ATLAS in the future. This particularly refers to the inclusion of a contract row in order to enable derivation of data to supplier group level.
  - ✓ When ATLAS is fully implemented, the Inbound related operational measurements can be added to the supplier performance dashboard.

General recommendations

- **Share the information in the dashboard with the suppliers.** The supplier performance dashboard will be useful not solely within the VLC organization but also in the relationship between VLC and the core suppliers. The dashboard will act as a tool for communication and create a closer relationship between the supplier and VLC where common action towards a better result within several questions and areas can be accomplished.
  - ✓ It was found that the suppliers in general are positive towards a supplier performance dashboard, and particularly take part of the supplier measurements of VLC.
  - ✓ Important to notify though, is that the suppliers do not desire to be measured on anything but what has been agreed upon in the contracts.
- **Extend the areas of application –** The dashboard is primarily intended for the supplier management forum. However, the intension is to extend the applicability to use the dashboard in other contexts as well. A requirement on the dashboard that have been emphasized in this thesis is to allow data aggregation and drill down. If this requirement can be fulfilled, it would enable deployment of the supplier performance dashboard in areas where a more detailed level of analysis is required.

- **Consider the fifth implementation step –** Revise the definitions and standards for future metrics. Evaluate possibilities for more standardized measurements. This refers particularly to measurements that are categorized as future KPIs in this thesis, such as Overall safety, Contingency plan and CSR compliance.

8 Future Research

The scope of this master thesis has been relatively broad and it covers many aspects regarding purchasing, supplier assessment, performance indicators and dashboard application. Nevertheless, the study has had its limitations and there are several areas that can be investigated further and are suggested for future research. First of all, this study was carried out as a case study at VLC; a company within the automotive industry that buys transportation services and packaging material. The findings in this thesis are very specific for the operations of VLC; the performance indicators that were chosen for the dashboard are aligned with the specific strategy and goals of the company. Nevertheless, some elements of the content in the dashboard may be generalizable to other contexts besides the logistics and automotive industry, and the development of a framework for dashboard design is an interesting subject for future research.

Furthermore, it was not within the scope of our thesis to provide a technical solution for the dashboard to VLC. However, it is something that could be interesting to evaluate further; to closer examine the determining factors for a specific dashboard solution and assess how different dashboard systems can benefit a company. It would also be interesting to further investigate how the dashboard can be used in the strategy development work. Theory behind portfolio analysis was provided in this thesis but to evaluate how the dashboard may be adjusted depending on the strategic importance of the supplier could be interesting to evaluate further.

Finally, findings in this thesis indicate that the suppliers of VLC were positive to the idea of a dashboard and were interested in taking part of the information. For future research, it is interesting to further evaluate how the dashboard can be used to increase the efficiency of the relationship to the suppliers. The relationship between buyers and suppliers is closely aligned with the strategy development work and possibly, these two subjects; strategy development work and supplier relationships in the context of dashboard application can be studied jointly.

References

AB Volvo, 2007a. *Inbound.* [Online]
Available at: http://www.volvologistics.com/logistics/global/en-gb/Logistic%20solutions/Inbound/Pages/Inbound.aspx
[Accessed 29 February 2012].

AB Volvo, 2007. *Quality, safety and environmental care -our corporate values.* [Online]
Available at: http://www.volvologistics.com/SiteCollectionDocuments/VL/Library/Gent/Quality%20Safety%20and%20Environmental%20Care.pdf
[Accessed 5 Mars 2012].

AB Volvo, 2011. *Inbound.* [Online]
Available at: http://violin.volvo.net/volvologistics/corporate/en/businessfunctions/inbound/Pages/inbound.aspx
[Accessed 29 February 2012].

AB Volvo, 2011. *Inbound Traffic.* [Online]
Available at: http://violin.volvo.net/volvologistics/corporate/en/businessfunctions/inbound/functions/traffic/pages/inbound_traffic.aspx
[Accessed 29 February 2012].

AB Volvo, 2011. *Inbound Traffic Management and Customer Service.* [Online]
Available at: http://violin.volvo.net/volvologistics/corporate/en/businessfunctions/inbound/functions/traffic/traffic_management/Pages/traffic_management_and_customer_services.aspx
[Accessed 29 February 2012].

AB Volvo, 2011. *Invoicing & Cost Control.* [Online]
Available at: http://violin.volvo.net/volvologistics/corporate/en/businessfunctions/finance/ICC/Pages/default.aspx
[Accessed 29 February 2012].

AB Volvo, 2011. *Press release - Effektivare logistik minskade Volvokoncernens koldioxidutsläpp med 22 procent.* [Online]
Available at: http://www.vfsco.com/financialservices/norway/no-no/nyheter/_layouts/CWP.Internet.VolvoCom/NewsItem.aspx?News.ItemId=102981&News.Language=sv-se
[Accessed 2 Mars 2012].

AB Volvo, 2012. *Annual Reports: Volvo Group Global.* [Online]
Available at: www.volvogroup.com
[Accessed 4 February 2012].

AB Volvo, 2012. *Finance and Business control.* [Online]
Available at:
http://violin.volvo.net/volvologistics/corporate/en/businessfunctions/finance/Pages/finance.aspx
[Accessed 29 February 2012].

AB Volvo, 2012. *Volvo Grop Sverige - Våra värderingar.* [Online]
Available at: http://www.volvogroup.com/group/sweden/sv-se/Volvo+Group/ourvalues/pages/volvovalues.aspx
[Accessed 09 May 2012].

Aberdeen Group , 2010. *QlikView Customers Outperform the Best-in-Class with Dashboards,* s.l.: Aberdeen Group.

Aberdeen Group, 2002. *www.lyonsinfo.com.* [Online]
Available at: http://www.lyonsinfo.com/_resources/Aberdeen_SPMS_Report.pdf
[Accessed 02 02 2012].

Aberdeen Group, 2009. *Executive dashboards the key to unlocking double digit profit growth,* s.l.: Aberdeen Group.

Analytics in motion, 2012. *Analytics in motion.* [Online]
Available at: http://www.analyticsinmotion.net/services-business.html
[Accessed 10 May 2012].

Andersson, D. & Norrman, A., 2002. Procurement of logistics services - a minutes work or a multi-year project?. *European Journal of Purchasing & Supply Management,* 8(1), pp. 3-14.

Asmild, M., Paradi, J., Reese, D. & Tam, F., 2007. Measuring overall efficiency & effectiveness using DEA. *European Journal of Operational Research,* 178(1), pp. 305-321.

Baily, P., Farmer, D., Jessop, D. & Jones, D., 2005. *Purchasing principles and management.* 9th ed. Essex: Pearson Education Limited.

Beatham, S., Anumba, C., Thorpe, T. & Hedges, I., 2004. KPIs: a critical appraisal of their use in construction. *Benchmarking,* 11(1), pp. 93-117.

Birkland, C., 2002. Stating the obvious. *Fleet Equipment,* 28(2), p. 4.

Boyson , S., Corsi, T., Dresner, M. & Rabinovich, E., 1999. Managing effective third-party logistics partnerships: what does it take?. *The Journal of Business Logistics,* 20(1), pp. 73-100.

Bryman, A. & Bell, E., 2003. *Business research methods.* Oxford: Oxford University Press.

Bryman, A. & Bell, E., 2011. *Business Research Methods.* Oxford: Oxford University Press.

Caplice, C. & Sheffi, Y., 1995. A Review and Evaluation of Logistics Performance Measurement Systems. *The International Journal of Logistics Management,* 6(1), pp. 61-74.

Car lovers magazine, 2010. *Car lovers magazine.* [Online]
Available at: http://www.carloversmagazine.com/index.php/2010/11/22/2011-chrysler-300c-images-revealed-australian-launch-in-2012/
[Accessed 10 05 2012].

Charron, K., 2006. Why KPIs belong in supply chain contracts. *Supply Chain Management Review,* 10(2), pp. 22-28.

Chow, G., Heaver, T. & Henriksson, L., 1994. Logistics Performance: Definition & Measurement. *International journal of Physical Distribution & Logistics Management,* 24(1), pp. 17-28.

Christopher, M., 2005. *Logistics and supply chain management: creating value-added networks.* 3rd ed. Harlow: Pearson Education Limited.

Coyle, J. J. et al., 2009. *Supply Chain Management a logistics perspective.* 8th ed. Mason: Cengage Learning.

Dorestani, A., 2009. *The association between non-financial key performance indicators and accounting and market-based, quality of earnings, and analysts' of forecasts.* Memphis: University of Memphis.

Eckerson, W., 2011. *Performance Dashboards: Measuring, Monitoring, and Managing Your Business.* 2nd ed. Hoboken: John Wiley & Sons.

Franceshini, F., Galetto, M. & Maisano, D., 2007. *Management by measurement: designing key indicators and performance measurement systems.* Berlin Heidelberg: Springer.

Gadde, L.-E., Håkansson, H. & Persson, G., 2010. *Supply Network Strategies.* 1st ed. Wiltshire: John Wiley & Sons.

Ghauri, P. & Grønhaug, K., 2005. *Research Methods in Business Studies.* 3rd ed. Essex: Pearson Education Limited.

Gordon, S., 2005. Seven Steps To Measure Supplier Performance. *Quality Progress,* 38(8), pp. 20-25.

Gordon, S., 2008. *Supplier Evaluation and Performance Excellence: A Guide to Meaningful Metrics and Successful Results.* Florida: J. Ross Publishing.

Gunasekaran, A., Patel, C. & McGaughey, R. E., 2004. A framework for supply chain performance measurement. *International Journal of Production Economics,* 87(3), pp. 333-347.

Handfield, R., Walton, S. V., Sroufe, R. & Melnyk, S. A., 2002. Applying environmental criteria to supplier assessment: A study in the application of the Analytical Hierarchy Process. *Journal of Operations Management,* Issue 141, pp. 70-87.

Holter, A. R., Grant, D. B., Ritchie, J. & Shaw, N., 2008. A framework for purchasing logistics services in small and medium size enterprises. *International Journal of Physical Distribution & Logistics Management,* 38(1), pp. 21-38.

Kaplan, R. S. & Norton, D. P., 1992. The Balanced Scorecard: Measures that drive performance. *Harward business review,* 70(1), pp. 71-79.

Kaplan, R. S. & Norton, D. P., 1996. *Translating Strategy into Action: The Balanced Scorecard.* Boston: Harvard Business School Press.

Kraljic, P., 1983. Purchasing must become supply management. *Harvard Business Review,* 61(5), pp. 109-117.

Krauth, E., Moonen, H., Popova, V. & Schut, M., 2005. *Performance measurement and control in logistics service providing.* s.l., s.n., pp. 239-247.

Krauth, E., Moonen, H., Popova, V. & Schut, M., 2005. Performance measurement and control in logistics service providing. In: C. S. Chen, J. Filipe, I. Seruca & J. Cordeiro, eds. *Proceedings of Seventh international conference on enterprise information systems.* s.l.:ICEIS, pp. 239-247.

Kungliga ingenjörsvetenskapsakademien, IVA, 2002. *Energianvändning i transportsektorn.* [Online]
Available at:
http://www.iva.se/upload/Verksamhet/Projekt/Energiframsyn/Transport%20komplett3.pdf
[Accessed 10 May 2012].

Lai, K.-H., Ngai, E. & Cheng, T., 2004. An empirical study of supply chain performance in transport logistics. *International Journal of Production Economics,* pp. 321-331.

Malik, S., 2005. *Enterprise dashboards: design and best practices for IT.* Hoboken: John Wiley & Sons.

Menon, M. K., McGinnis, M. A. & Ackerman, K. B., 1998. Selection criteria for providers of third-party logistics services: An exploratory study. *Journal of Business Logistics,* 19(1), pp. 121-137.

Neely, A., 1999. The performance measurement revolution: why now and what next?. *International Journal of Operations & Production Management,* 19(2), pp. 205-228.

Neely, A., Gregory, M. & Platts, K., 1995. Performance measurement system design A literature review and research agenda. *International Journal of Operations & Production Management,* 15(4), pp. 80-116.

Parmenter, D., 2009. *Key performance indicators - developing, implementing and using winning KPIs.* 2nd ed. Hoboken: John Wiley & Sons.

Rasmussen, N., Chen, C. Y. & Bansal, M., 2009. *Business Dashboards A visual catalog for design and deployment.* Hoboken: John Wiley & Sons.

Sarkar, A. & Mohapatra, P. K., 2006. Evaluation of supplier capability and performance: A method for supply base reduction. *Journal of Purchasing & Supply Management,* Volume 12, pp. 148-163.

Saunders, M., Lewis, P. & Thornhill, A., 2009. *Research methods for business students.* 5th ed. Essex: Pearson Education Limited.

Schmitz, J. & Platts, K. W., 2004. Supplier logistics performance measurement: Indications from a study in the automotive industry. *International Journal of Production Economics,* 89(2), pp. 231-243.

Simpson, P. M., Siguaw, J. A. & White, S. C., 2002. Measuring the Performance of Suppliers: An Analysis of Evaluation Processes. *The Journal of Supply Chain Management,* 38(1), pp. 29-41.

Skjøtt-Larsen, T., Schary, P. B., Mikkola, J. H. & Kotzab, H., 2007. *Managing the global supply chain.* 3rd ed. Gylling: Copenhagen Business School Press.

Smith, H. & Fitch, T., 2009. Application of relationship marketing & management: a large contractor case study. *Construction Management & Economics,* Volume 27, pp. 399-410.

Sundtoft Hald, K. & Ellegaard, C., 2011. Supplier evaluation processes: the shaping and reshaping of supplier performance. *International Journal of Operations & Production Management,* 31(8), pp. 888-910.

Talluri, S. & Sarkis, J., 2002. A model for performance monitoring of supplier. *International Journal of Production Research,* 40(16), pp. 4257-4269.

Töyli, J., Häkkinen, L., Ojala, L. & Naula, T., 2008. Logistics & financial performance: An analysis of 424 Finnish small and medium-sized enterprises. *International Journal of Physical Distribution & Logistics Management,* 38(1), pp. 57-80.

van der Valk, W. & Rozemeijer, F., 2009. Buying business services: towards a structured service purchasing process. *Journal of Services Marketing,* 23(1), pp. 3-10.

van Laarhoven, P., Berglund, M. & Peters, M., 2000. Third-party logistics in Europe. *International Journal of Physical Distribution & Logistics Management,* 30(5), pp. 425-442.

van Veele , A. J., 2005. *Purchasing & Supply Chain Management: Analysis, Planning, Strategy and Practice.* 4th ed. Croatia: Thomson Learning.

van Weele, A. J., 2010. *Purchasing and Supply Chain Management.* 5th ed. Hampshire: Cengage Learning EMEA.

Watson, H. J., 2006. Dashboards and Scorecards. *Business Intellegence Journal,* 11(2), pp. 4-7.

Williams, S. & Williams, N., 2007. *The profit impact of business intelligence.* 1st ed. San Francisco: Elsevier Inc..

Volvo Group, 2012. *Report on the fourth quarter and full-year 2011,* Gothenburg: AB Volvo.

Volvo Logistics Corporation, 2010. *P2P & CIC in general,* Gothenburg: Volvo Logistics Corporation.

Appendix 1 – List of interviewees

Position	Department
1. Manager	Purchasing Strategy & Support
2. Senior Vice President	Global Purchasing
3. Strategy Manager	Purchasing Strategy & Support
4. Business Process Manager	Purchasing Strategy & Support
5. Supplier Development	Purchasing Strategy & Support
6. Solutions manager VeSA & generic contract dev.	Purchasing Strategy & Support
7. Manager Transportation Purchasing Outbound	Purchasing Transportation Outbound
8. Purchaser	Purchasing Logistics Services, Emballage & NAP
9. Purchaser	Purchasing Transportation Inbound & Emballage
10. Contract Manager	Purchasing Transportation Inbound & Emballage
11. Business Analyst	Proc. Develop. Inv. & Cost Ctrl
12. Manager	Traffic Management & Customer Service
13. Coordinator Insurance and Claims	Risk Management
14. Head of Operational Excellence	Operations Excellence
15. Manager Operation Emballage	Emballage Operations
16. Purchaser	Purchasing Transportation Inbound & Emballage
17. Purchasing Analyst	Purchasing Strategy & Support
18. Purchasing Assistent	Purchasing Strategy & Support
19. Environmental Manager	Operations Excellence
20. Core value Analyst	Operations Excellence
21. Manager/Emballage GBO	Order & Distribution
22. Business Process Mgr Outbound	Outbound Operations
23. Manager Distribution Planning & Contrl	Outbound Operations
24. Manager Planning	Emballage Operations
25. Outbound Business Analyst	Outbound Operations
26. Outbound Business Analyst	Outbound Operations
27. Application Manager	Solutions Management
28. Purchaser	Global Purchasing
29. Supplier developer	Outbound Operations
30. Purchaser	Purchasing Logistics Services, Emballage & NAP
31. Business Analyst	Solutions Management
32. Change Management project leader	Solutions Management
33. Procurement controller	Emballage Operations
34. Technical Consultant	ARIBA
35. Technical Consultant	QlikView

Appendix 2 – Generic interview guide

- Describe your department and how it is organized within VLC?
- Describe your job?
- How do you currently measure the performance of your suppliers?
    - Which KPIs is included?
    - With which frequency do you measure these KPIs?
    - In which unit is these KPIs measured?
    - In which systems are these KPIs measured?
    - How is the suppliers identified in these measurements?
        - PARMA-ID?
        - Other identification?
    - How are the suppliers separated if used within different traffic modes?
- Do you have performance levels stated for each supplier?
- Is the same measurements used globally?
    - If not, how are the measurements carried out in different geographical areas?
- How is deviations measured and logged?
- How is the quality of the measures ensured?
- How are problems with a supplier handled within your organization?
    - Do you have an escalation ladder involving the purchasing department?
- Do you have any other thoughts or ideas regarding a Supplier performance dashboard you would like to share with us?

Appendix 3 – Interview with suppliers

List of interviewees

- One rail supplier
- Two sea suppliers
- Two road suppliers

Interview guide

- Do you currently measure your performance as a supplier towards VLC?
    - If yes, which KPIs do you measure?
    - Do you share this information with VLC?
- Do you measure any other customers, excluding VLC, in a good way you would like to share?
- Do you currently measure the performance of your own suppliers?
    - If yes, which KPIs do you measure?
    - Do you present or visualize these KPIs in any specific way?
- Which measurements do you consider most important to perform on towards your customers?
- Which KPIs would you like to be measured upon from your customers?
- Do you currently measure your emissions of CO_2 and other emissions?
    - Do you measure annually or on a more frequent basis?
    - If yes, would you consider sharing this information with VLC? Possibly self-report into the Supplier performance dashboard?
- Do you have any other ideas or thoughts regarding a Supplier performance dashboard that you would like to share with us?

Appendix 4 – Interview guide for purchasers

The purchasers within the Global purchasing department located at the Gothenburg office was asked to rank their five most important measurements when evaluating the performance of a supplier and send the answer back by mail. They were encouraged to consider all possible areas of KPIs; operational, financial and core value related measurements.

The purchasers was also asked to state which traffic mode or traffic modes these ranked measurements are relevant for. See table 28 below for the result of this ranking.

Table 28; Ranking of important measurement when evaluating suppliers, according to purchasers within the Global Purchasing department in Gothenburg

MEASUREMENTS	SEA	ROAD	RAIL	EMB	LOG SERV	OTHER	SUM
Price/Cost	1	4		2	1	1	9
Leadtime/Precision	1	6		1	1		9
Financial ranking	1	1		2	1	1	6
Damage free delivery	1	2	1			1	5
Quality	1	1		2	1		5
ISO 14001/9001/SmartWay		1		2	1		4
CSR		1		1	1		3
Future potential	1	1		1			3
Invoice quality	1		1				2
Service, daily contact quality		2					2
Capacity, large versus small supplier		1				1	2
Asset owner		2					2
IT integration level med Volvo/EDI		1				1	2
Reporting quality	1						1
Wagons for loading			1				1
Wagons on service/repair			1				1
Environmental impact		1					1
Brand management aspects						1	1
IT Competence						1	1
Flexibility		1					1
Trust						1	1
Capacity, booked equals confirmed orders	1						1
Geographical location				1			1
Acceptance of SOP		1					1

Appendix 5 – Summary of measured KPIs

Table 29; Summary of all identified metrics measured within all investigated departments at VLC

Possible KPI:s	System (present)	System (future)	Identification	Global/Regional
Financial ranking	External	External	Supplier group level	Regional, Europe
Spend	Excel	LES?	PARMA-ID	Global
IB Delivery Precision	TIR/FADS/ATLAS	ATLAS	Lane-level	Regional, Europe
IB Pick-up Precision	TIR/FADS/ATLAS	ATLAS	Lane-level	Regional, Europe
IB Lead time	TIR/FADS/ATLAS	ATLAS	Lane-level	Regional, Europe
IB Deviation Reporting	TIR/FADS/ATLAS	ATLAS	Lane-level	Regional, Europe
OB Delivery target fulfillment	A4D	A4D	Lane-level	Global
OB Arrival reporting	A4D	A4D	Lane-level	Global
OB Departure reporting	A4D	A4D	Lane-level	Global
OB Lead-time	A4D	A4D	Lane-level	Global
EMB Delivery precision	N/A	LES	Supplier-level	Global
EMB/IB Unloading precision	V-EMS	LES	PARMA-ID	Regional, Europe
ISO 9001	Excel		Supplier group level	Global
ISO 14001/SmartWay	Excel		Supplier group level	Global
Motor class, average	Supplier Survey	-	Supplier group level	Regional, Europe
CO_2 emissions, g/ton-km	Supplier Survey	-	Supplier group level	Regional, Europe
Clean Shipping Index	Clean Shipping Index	-	Supplier group level	Global* (Europe based suppliers)
Contingency plan	Supplier Survey	-	Supplier group level	Global
CSR Compliance	Supplier Survey	-	Supplier group level	Global
Overall Risk	Supplier Survey	-	Supplier group level	Global
Transport Quality, number of damages	RMS	RMS	Supplier group level	Global
Transport Quality Audits	RMS	RMS	Supplier group level	Global
Number of parked invoices due to supplier errors, divided by total number of invoices (Invoice quality)	CIC/SAP	LES	PARMA-ID	Regional, Europe
Number of automatically matched CIC lines/total number of CIC lines	CIC/SAP	LES	PARMA-ID	Regional, Europe
Number of overdue invoices/total number of invoices	CIC/SAP	LES	PARMA-ID	Regional, Europe
Number of parked invoices/total number of invoices, defined according to labels	CIC/SAP	LES	PARMA-ID	Regional, Europe

Appendix 6 – Background information on ATLAS and LES

IT-project ATLAS

Within the Inbound GBO there is an ongoing IT-project for a new system support called ATLAS. Currently three systems are used globally; TIR, FADS and ATLAS. TIR and FADS will eventually be replaced by ATLAS and in the future ATLAS system, the same KPIs for supplier evaluation will be used and the same working procedures concerning these issues can be applied globally. The intension is to have a global system that enables consistency in the measurements regardless of location around the world, which is hard to achieve with separate systems. The implementation of ATLAS will enable the inclusion of all operational metrics regarding Inbound into the dashboard.

Some of the new functionalities in ATLAS will be introduced in mid-May, beginning of June in 2012, but additional functionalities will not be implemented until the end of year 2012. The first roll-out will cover the European road operations and additional areas will be added in later stages.

IT-project LES

An ongoing IT-project called LES affects several departments in relation to the metrics and measurements recommended for the dashboard. The system developed within the LES project is an SAP solution that will be used within both the I&CC department as well as the Emballage GBO.

When implementing LES within I&CC instead of today's system, CIC, this will enable the department to measure the quality of the supplier's invoices on a global scale and allows the KPIs of Invoice Quality and Spend to be automatically fed from the system into the dashboard on a monthly basis. The LES project also concerns the Emballage GBO and will enable them to measure Delivery precision of new packaging material, something that their current system of V-EMS is unable to provide.