Investigation on improvement potential within IMLOG’s Lead Logistics Provider concept

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Finalising the Master of Science Transport, Infrastructure & Logistics (MSc. TIL) at the Delft University of Technology (DUT) requires the execution of a graduation project. This project accounts for thirty credits and should take a six months at minimum to complete. The subject of the project should be related to at least two of the three disciplines (transport, infrastructure and logistics) of the MSc. TIL. From each student of the MSc. TIL is expected to make the arrangements for conducting the Master thesis project at the university or at a company. Completing the research project will result in report which represents the work performed in the project. A summary of the graduation work is included in this report.

My search for a suitable MSc. Thesis project brought me to IMLOG (InterModal Logistics), a European logistic service provider, with a special focus on intermodal containerised transport. IMLOG offered me a position to conduct my Master Thesis project within their company. The subject of the project proposed by IMLOG resulted from the current services provided for Producer A (PRODA). An essential part of the graduation project includes the evaluation of this concept for PRODA, followed by suggestions to improve the concept. Looking at the short company and the project description, it can be concluded that the subject of the graduation project has a close relation with the “transport” and the “logistics” part of the MSc. TIL.

By reading this report I hope that you will obtain a good understanding of logistics and how IMLOG could serve their clients in a better way by improvement of their Lead Logistic Provider concept. The conducted MSc. Thesis project is commissioned by IMLOG, where the author’s experience and opinion are reflected in this report. This does not mean that IMLOG opinion on the matter corresponds to the author’s opinion.

Due to the confidential character of the graduation project, the real names of the logistics service provider and the company to which the logistics services are provided are replaced by fictive names. In addition, several informative parts in the report are made unrecognisable as well due to the same reason.

May 2011,

B.D. van Noortwijk
Summary
As a response to the current negative developments in the chemical business, IMLOG developed its Lead Logistics Provider concept for PRODA. This concept takes care of all road and intermodal (containerized) transports of liquid bulk chemicals of PRODA throughout Europe. Most of the transports are performed by IMLOG, but for specific transports IMLOG is supported by LLP transport partners.

After almost two years operating the concept issues have arisen, which indicates that there is room for improvement within IMLOG’s LLP concept. Eye-catching issues involve lost of market feeling by PRODA, poor concept success measurement and operational inefficiencies.

These issues formed the motive for a project to first identify IMLOG’s LLP concept related issues, followed by the determination of the improvement opportunities resulting from these issues. Finally the carefully selected improvement opportunity is elaborated by means of a functional design. Therefore the following design objective is adopted within the project:

*Design an improvement measure based on a carefully selected improvement opportunity within IMLOG’s LLP concept.*

To be able to fulfil the project objective certain problem design questions are formulated. Answering these question guides the design objective fulfilment process. These problem design questions go in more detail on:

- Understanding on the LLP concept from a theoretical perspective.
- Understanding on IMLOG’s LLP concept for PRODA.
- To what extend IMLOG can be classified as a LLP.
- Lessons to be learned from comparing theory with practice and practice itself.
- Factors that influence the decision for elaborating on a certain improvement opportunity.
- Fundamental changes related to the functional design.
- Important topics towards implementation.

PART I – Identification of IMLOG’s Lead Logistics Provider concept issues
The LLP concept is a form in which a LSP provides its logistics service to its clients. Just like other logistics provider forms, a LLP creates value by relating the buyer and the seller of a product. Outsourcing of logistics activities by the buyer or seller determines to be the reason why LSP exist. The relationship between the LSP, the buyer and/or the seller can range from pure transactional towards fully relational. A relationship on partner level (a partnership) arises when LSPs are involved in the business of its customer on a strategic level. Success of a partnership depends on qualitative and quantitative factors for which both the logistics services serve as input. Logistics services are being delivered by combining resources under control of coordination mechanisms.

From a theoretical perspective the LLP concept can be classified as a hybrid of an operational 3PL with the responsibilities of a 4PL. Characteristics of the LLP concept (LLP key success factors) are derived from this classification. Operating the LLP concept should also contribute in relieving the logistics business from currently experienced issues. Therefore a set of structural issues, also known as pitfalls, is formulated. The LLP key success factors and pitfalls will serve as starting point in the determination of IMLOG’s LLPness by comparing literature with practice.

IMLOG’s LLP concept was initiated by PRODA’s need for lower logistics costs, improved customer service levels and improved sustainability within the supply chain. Within the LLP concept a distinction is being made between physical and administrative logistics services. Main physical logistics services involve transportation, storage and container cleaning. LLP transport partner management, transport order and transport chain coordination, payment portal, track & trace and optimisation/integration are considered to be administrative logistics services provided by IMLOG’s LLP concept for PRODA. The organisational structure of the LLP concept is mainly formed around the
four types of transport offered by the IMLOG’s LLP concept: LLP transport partner transport, short
distance road transport, long distance road transport and intermodal transport.

Issue are identified by determination of IMLOG’s LLPness from a theoretical perspective and
investigation of the IMLOG’s LLP concept in practice. The determination of IMLOG’s LLPness resulted
in concept issues. The quality level of the partnership between IMLOG and PRODA involving the LLP
concept is medium, where improvement can be realised by focussing more on the relational
elements in the partnership instead of the operational ones. IMLOG’s LLP concept for PRODA fulfils
50 percent of the LLP concept critical success factors identified. Four of the critical success factors are
not fully met, but with slight changes in the concept these factors could also be met. Only one critical
success factors scores very low on IMLOG’s LLP concept for PRODA: IMLOG fulfils no leading role in
logistics, supply and demand chain integration. From this can be concluded that IMLOG cannot be
classified as a LLP in the concept it provides for PRODA from a theoretical perspective. With
confronting IMLOG’s LLP concept for PRODA with the pitfalls identified in literature it can be
concluded that most of the pitfalls are encountered. No continuous improvement, no extensive
performance measurement programme and a lack of pro-activity are the most important pitfalls
encountered. On the other hand with its LLP concept IMLOG was able to completely avoid the pitfalls
involving a lack of flexibility and tailored systems and structures and the absence of pan European
coverage.

Investigation of IMLOG’s LLP concept in practice resulted in relationship issues, service fulfilment
issues and business process issues. The relational issues originate from unmet expectations by
PRODA caused by the absence of extensive benchmark activities in the concept and pro-active
information supply from IMLOG’s side. Service fulfilment issues are identified by analysing
performance data from the beginning of IMLOG’s LLP concept for PRODA. It can be concluded that
the service levels are increased against lower cost after the deployment of IMLOG’s LLP concept for
PRODA. Nevertheless the performance data show that the number of underweight shipment and the
number of late deliveries know very unstable behaviour, which can be identified as the two main
service fulfilment issues. Numerous business process issues are identified which are involved to the
daily key operational processes within IMLOG’s LLP concept for PRODA. Most of the issues identified
involve internal processes of IMLOG LLP department, where a few issues are related to the interface
between IMLOG, the LLP transport partners and PRODA.

PART II – Determination of improvement opportunities & selection

The identified issues serve as input for the determination of four main improvement opportunities
within IMLOG’s LLP concept. The first step in this determination process involves clustering the
identified issues in three improvement domains: the relationship domain, the service fulfilment
domain and the business process domain. Based on the issues clustered in the three improvement
domains, four main improvement opportunity types are derived. First type of improvement
opportunity involves business approach change, which results from the relationship domain. If
IMLOG would like to adopt itself towards the theoretical LLP, certain major changes cannot be by-
passed. These changes will influence IMLOG’s current way of performing business: its business
approach.

The second improvement opportunity defined is Customer Relationship Management (CRM), derived
from the relationship domain as well. CRM provides an integral approach with a focus on customer
development and customer retention. By adopting a CRM strategy unmet expectations at the
customer’s side can be eliminated through a good understanding of each other perception of
requirements and performance. Enabling factors in CRM are availability of information and the use of
an extensive performance measurement programme.

The third improvement opportunity defined is the performance measurement structure. Both
identified concept issues and service fulfilment issues shows that performance measurement in
IMLOG’s LLP concept is not optimal. By developing and implementing an extensive performance
measurement structure, the related issues can be solved.
The fourth type of improvement opportunity lies in business process change solving the service fulfilment and business process issues clustered in the domains of the same name. All except two identified business change improvement opportunities are directly related to operational functions within IMLOG’s LLP concept; the remaining two involve supporting functions. Based on the nature of the business process change improvement opportunity identified a certain change programme are proposed; ranging from rightsizing to business reengineering.

The selection for a certain improvement opportunity to elaborate upon is made by comparing all identified improvement opportunities on four factors. These factors are facilitation of growth, improvement of internal performance, creating a win-win situation and the challenge in the elaboration process. In close collaboration with IMLOG is agreed that business process change involve the most promising improvement opportunities. When improving IMLOG’s internal business processes, not only IMLOG benefits as well, by higher services levels and probably reduced costs. In special the container assignment process will be main topic of interest within the design task. Reengineering the container process will result in a totally new process design on container assignment, although some basic principles will be applied in the assignment processes.

**PART III – Design of an integral container management system**

Besides the container assignment process, two other container management functions can be improved through centralisation. Taking these two additional container management functions into account next to the container assignment process, a functional design of an integral container management system is developed. This system knows three main functions: container assignment, container maintenance coordination and empty container repositioning. The key in the integral container management system is that all three container management functions are centralised in the Centralised Container Management System (CCMS). This is in contrast with the current situation where these three functions are managed on a regional level. Following this design task scoping process requirements are formulated which serve as input for the CCMS’s functional design development process.

Within the CCMS each container management function knows a process for which a functional design is made. The container profile, containing all information on container characteristics, is the main element within these three processes. For the container assignment process the shipment order profile, containing the shipment order characteristics, is essential as well. In this process a container is assigned to a certain shipment order based on a match between the container and shipment order profile. Database checks and incidental notifications trigger the container maintenance coordination process through which all arrangements for maintenance are made. Empty container repositioning is responsible for solving imbalances in IMLOG’s network involving empty containers. Empty containers are shipped to the areas in IMLOG’s network where they are needed the most. For each of the processes the involvement of different actors including their interfaces is presented. Key Performance Indicators are proposes as well to be able to measure the performance of the three processes and the CCMS in total. All but one of the earlier defined requirements are fulfilled within the functional design presented. The requirement that was not fully fulfilled within the design proved to be not accurate according practice. Issues being solved and efficiency improvement of the container management related processes are highly expected when implementing the presented functional CCMS design.

To provide insight in the steps prior to the CCMS implementation, important topics are identified. Resources needed in the process toward a full operational CCMS are addressed, including the costs related to this process. The importance of change management in the development and implementation phase is discussed as well. Automation thru a Decision Support System (DSS) can be identified as a major factor in optimisation of the container management processes. Therefore the principles of a Decision Support System are discussed. Eventually steps concerning further development towards a full operational CCMS are identified.
Conclusions & recommendations

The design objective in this project is fulfilled by identification of issues and improvement opportunities, selection of one from which a functional design is made. Looking at IMLOG’s LLP concept it can be concluded from a theoretical perspective that IMLOG does not fully fulfils the profile of a true LLP from a theoretical perspective. Although the current form of IMLOG’s LLP concept could perfectly be developed towards a true LLP. The identified issues serve as perfect opportunities in this development process.

Looking at the current practice of the IMLOG’s LLP concept a lots of improvement opportunities can be identified. Optimisation of internal operational processes forms in here a perfect start. Additionally a stronger focus on relationship management in IMLOG’s LLP concept is needed to improve customer satisfaction. An extensive performance measurement structure will support relationship management, but provides more detailed insight on IMLOG’s internal performance as well. To take full advantage of the extensive performance measurement structure an appropriate Information system is needed. An extensive information system will enable optimisation of IMLOG’s internal processes through automation as well.

For successful implementation of the CCMS, a broader scope in the development process must be adopted. This allows the design to be tailored to its environment which should positively influence the CCMS performance on the long run. Automation is a very important enabling factor in improving the efficiency of processes; therefore a high level of automation should be applied within the CCMS. The success of the CCMS depends on highly on the support within the IMLOG company: change management should be extensively applied in creating this support. Furthermore opportunities on including multiple order assignment per container per day, real-time container assignment and integration of transport planning and the CCMS should be investigated for further efficiency improvements.
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General introduction

European chemical business threats
The current European chemical industry is facing more and more competition from countries in Eastern Europe, Russia, Asia and the Middle East. Several reasons can be given why Europe’s global leadership in the chemical business is demerging: lack of innovation within Europe’s chemical industry, uncertainties in Europe’s trade balance, shrinking capital investments and a less favourable business environment (Braithwaite, 2002; Braithwaite, 2005; Ketels, 2007; Sloten, 2004). Especially transport and logistics have a big influence on the less attractive business environment for the chemical industry. Costs involved with transport and logistics, also known as supply chain costs, involve around 50 percent of the added value in the chemical industry. This percentage can be considered as relatively high where supply chain costs represents 18 percent of the added value in fabricated metal project business (Braithwaite, 2002).

A consequence of Europe’s less favourable business environment and its relatively high supply chain costs, chemical companies tend to move their production to countries outside Europe. To stop the exodus of chemical companies out of Europe and to ensure Europe’s long-term competitiveness in the chemical business, measures have to be developed and implemented.

Need for Logistic Service Provider improvement
Different studies have been conducted by the EPCA, ECTA and CEFIC to identify which topics should be optimised to improve the performance in the chemical industry’s supply chain. Research by the EPCA, ECTA and CEFIC state that improving the Logistic Service Provider (LSP) performance has the biggest potential to improve the chemical supply chain’s performance (Braithwaite, 2002; Braithwaite, 2005; ECTA, 2006; EPCA, 2007; McKinnon, 2004).

But why are the LSPs underperforming? Main reasons are the lack of strategic thinking and lack of implementing strategies in a pro-active way by LSPs. This can also be recognised as a lack of integration of LSPs in the chemical industry practices (McKinnon, 2009), where integration is a derivative of collaboration and coordination between the two parties. This behaviour is caused by the fact that chemical companies are treating logistics services as a commodity: they assure themselves not paying too much for the logistic services (Boughton et al, 2007; Cruijssen, 2006; Visser L. J., 2007; Rushton & Walker, 2009). This results in declining margins for LSPs, making it hard for them to invest in the development and implementation of new, innovative logistical service solutions for the chemical business. Figure A explains how this behaviour leads to a vicious circle.

![Figure A - Vicious circle characterising the logistics business (Cruijssen, 2006)](image)

Concluding, the collaboration and coordination (integration) between LSPs and chemical producing companies should be stimulated to improve the performance of the total chemical industry’s supply chain.
Lead Logistics Provider IMLOG integrates the supply chain

IMLOG developed itself from a regular transport company in the past, towards a leading LSP in containerised intermodal transport nowadays. The company recognises the threats that lead to the current declining performance of Europe’s chemical industry and the absence of an integral supply chain perspective in this industry. It also agrees on the fact that lots of potential savings can be realised by stimulating the collaboration and coordination in the supply chain regarding the logistics involved. Therefore IMLOG aims to be more than just a regular transport company.

In 2009 IMLOG implemented a newly developed logistics concept, which can be typified as a perfect example where closer collaboration and coordination between a LSP and a chemical producing company is being applied. Within this concept IMLOG fulfils the role of a Lead Logistics Provider (LLP). By providing the LLP concept for the chemical producing companies IMLOG is changing from a LSP into a company that is more and more focussing on logistics management. Logistics management is being recognised as a key to future success (McKinnon, 2001). From providing standardised logistics towards the search new solutions and system combinations to improve the quality of the logistics services provided.

The application of the LLP concept involves the coordination of all liquid bulk chemicals outbound logistics of ProducerA (PRODA) in Europe. The outbound logistics involve transports from PRODA’s production locations in location A and B and several storage locations throughout Europe. PRODA’s customers are situated throughout whole of Europe: from Portugal to Hungary and from Scandinavia to Greece.

IMLOG is does not have enough capacity throughout Europe to conduct each shipment by themselves. Therefore other transport providers are involved in this LLP concept. These transport providers conducting the transport of shipments in geographical regions where they have strategic advantage compared to transport provider IMLOG.

IMLOG is known as a leading LSP in intermodal transport, therefore the focus is to use intermodal transport as much as possible. For cases where intermodal transport is not profitable, road transport is being applied. Due to the focus on intermodal transport mainly containers are being used, which makes the transhipments of this type of load unit relatively easy compared to other types of load units. Tank trailers are being used as well in cases where road transport is applied.

Figure B - Essence of IMLOG’s Lead Logistics Provider concept
Figure B presents how coordination of the outbound logistics is being managed in IMLOG’s LLP concept for PRODA. PRODA receives orders from their customers; these orders are forwarded to IMLOG’s LLP department. Based on contractual agreements the LLP department decides which transport provider will be used for the transport coordination involved with the order. On request of each of the parties in figure B amendments on the order can be proposed. IMLOG’s LLP department fulfills a facilitating role in the amendments of these orders, because every proposed amendment has to be approved by IMLOG’s LLP department. For example when a PRODA customer requests a change of the order’s delivery date, the LLP department will be informed through PRODA. De LLP department will check with the LSP IMLOG or the involved LLP transport partner(s) if the proposed change is possible. Subsequently the PRODA customer will be informed through PRODA whether the proposed change is possible or not. If yes, the order will be amended; if no, the delivery date will remain unchanged. By having IMLOG as their LLP, PRODA have just one logistics business partner which makes coordination of the outbound logistics much easier and less costly for both parties.

The LLP concept itself is a relatively young concept in “the world of logistics”, where IMLOG was one of the first LSPs that introduced this concept in the chemical industry. After almost two years IMLOG has gained a lot of experience and knowledge by operating their LLP concept for PRODA. Although costs for both parties are reduced and the service level towards PRODA customers is increased, several issues regarding this LLP concept have arisen.

First issue involves PRODA’s experience market feeling. Due to the use of a LLP for their liquid bulk outbound logistics, PRODA experiences that they are lose the feeling of what is happening in the market.

A second issue involves the fact that current success of this LLP application is hard to measure. In the current situation the success of this LLP concept is solely measured by quantitative key performance indicators (KPI). Measuring the success of the LLP concept in this way is not fulfilling the needs of PRODA and IMLOG.

The third and last issue is related to the daily operations: the number of order amendments. IMLOG’s LLP department is experiencing a lot of order amendments each day. Sometimes an order is amended four times before the transport is conducted. These amendments are resulting in lots of work, effort and stress at IMLOG’s LLP department.
Generic issue solving approach

The general introduction concludes in three issues that have arisen after two years of operating IMLOG’s LLP concept for PRODA. These issues are symptoms of a not optimal performing situation: improvement is possible to create more success. In the preface is mentioned that this is exactly where IMLOG aims at with this project: improving its LLP concept by solving current issues. But how is it possible to improve IMLOG’s LLP concept by solving issues? Figure C shows in general how this process works. It starts with an element within IMLOG’s LLP concept, for instance a certain process. Experience from practice shows that in this case a certain process is underperforming: an issue concerning this particular process is identified. With having an issue, an improvement opportunity defines roughly how this issue can be solved. Concerning the underperforming process the improvement opportunity could involve redesign of related procedures. Based on this improvement opportunity a measure can be design which will solve the issue. The redesigned procedures can be classified as measures to improve the process performance in the example. Implementing the designed measure will influence the LLP concept element in a positive way by solving the issue. In case of the underperforming process, implementation of the redesigned procedure will lead to improved performance of the process.

The three issues mentioned in the general introduction form the main motive of conducting this master thesis project: they form the “tip of the iceberg”. To improve IMLOG’s LLP concept it makes sense not only take these three issues into account, but also other, unidentified issues. Due to the nature of the project and time restrictions it will not be possible to conduct all steps of the improvement cycle for each issue. Therefore the project will focus on the identification of the issues related to IMLOG’s LLP concept. Improvement opportunities will be determined for the identified issues. From the set of improvement opportunities, one improvement opportunity will be carefully selected to be elaborated upon. From this process a functional design of the improvement measure will result through which related issues should be solved when implemented.

Design objective & design problem questions

Within this project the improvement cycle ends in design a measure to improve IMLOG’s LLP concept. Taken the preceding steps into account, see previous paragraph, the following design objective within this project will be adopted:

*Design an improvement measure based on a carefully selected improvement opportunity within IMLOG’s LLP concept.*

Fulfilling the project’s design objective is not a simple task; many steps have to be taken. Problem design questions help to structure this process, where each question is related to an aspect of the
design objective. Within this design objective three aspects can be identified: “IMLOG’s LLP concept”, “the carefully selected improvement opportunity” and “design an improvement measure”. Before an appropriate measure can be designed, first understanding has to be obtained on IMLOG’s LLP concept. The following design problem questions related to this process:

How should the LLP concept be interpreted from a theoretical perspective? (A)
What is IMLOG’s interpretation of the LLP concept which it provides for PRODA? (B)

The next step involves the determination of the improvement opportunities and eventually the selection of one to be elaborated upon. This begins with the identification of all issues related to IMLOG’s LLP concept. Those issues will be identified by confronting practice with literature or solely investigating practices. Following the improvement opportunities will be derived from the set of issues, from which one improvement opportunity will be selected. The following design problem questions support this step:

To what extend does IMLOG fulfils the profile of a LLP according to literature? (C)
Which lessons can be learned from practice? (D)
Which factors influences the decision to elaborate on a certain identified improvement opportunity? (E)

Based on the selected improvement opportunity, a measure will be designed in the last step. Design problem question of importance in this last step are:

Which fundamental change(s) should be made when adopting the designed improvement measure? (F)
What are important aspects when implementing the functional design of the chosen improvement opportunity? (G)

These last mentioned design problem questions are rather general including the design objective mentioned above. Therefore at the start of the improvement measure design, the design objective and the problem design questions will be further specified according the selected improvement opportunity.

Steps towards design objective fulfilment
The improvement cycle in figure A will serve as starting point for fulfilling the design objective, although the implementation stage is not being considered. First step is to form a set of different types of issues, where first understanding on the LLP concept is obtained thru literature and practice. This process will lead to an answer on the design problem questions A and B. Following different types of issues are identified by answering design problem questions C and D. Based on the set of issues identified in the first step, related improvement opportunities can be determined: step two. As discussed before, not every improvement opportunity identified can be taken into account when design an appropriate improvement measure to solve the corresponding issues. Therefore the third step involves a careful selection of the improvement opportunity, where design problem question E plays a major role. Last step in fulfilling the design objective involves designing an improvement measure concerning the carefully selected improvement measure. In this step an answer to design problem question F and G will be formed. Figure C summarises the above mentioned steps in a diagram.
The previous chapters ended in providing the steps that have to pass through to come to a design of a measure based on the selected improvement opportunity within IMLOG’s LLP concept. The structure of this report is based on these steps, starting with the identification of the issues in the first part. Based on these issues, improvement opportunities are determined followed by the selection of an improvement opportunity in the second part. A measure will be designed in the third part of this report based on a carefully selected improvement opportunity. Figure D displays the methodology in and structure of the report based on these three parts, including the chapters that are responsible for elements within in each part.

For the identification of issues within IMLOG’s LLP concept practice and theory are confronted and the practice itself is investigated (chapter four and five). For this critical success factors and pitfalls are identified in chapter two, where IMLOG’s LLP concept for PRODA is in detail described in chapter three. The first part starts with an introduction on the essence of logistics in business due to the fact that the LLP concept involves logistics from a high level perspective.

From the issues identified in the first part of the report, opportunities to improve IMLOG’s LLP concept are derived. One of the improvement opportunities will be selected for further elaboration. These two steps will be performed in chapter six.

The selected improvement opportunity serves as main topic of interest in the design process. The design process starts with defining the scope of the design task in chapter seven. The defined scope of the design task will provide input for the set of design requirements which are formulated in chapter eight. In accordance with the design requirements imposed a functional design will be presented in chapter nine. Last step in the design process involves the identification of important topics that should be considered in the further development of the design towards implementation: chapter ten.
PART I

Identification of IMLOG’s Lead Logistics Provider concept issues

PART II
Selection

PART III
Design

Chapter 1
Essence of logistics in business

Chapter 2
The unique potential of the LLP concept

Chapter 3
A tailored logistics solution for PRODA

Chapter 4
IMLOG: a true LLP or not?

Chapter 5
Practical issue within IMLOG’s LLP concept

Chapter 6
Improvement opportunities & design subject

Chapter 7
Scoping the design task

Chapter 8
Design requirements

Chapter 9
Functional design

Chapter 10
Important topics towards implementation
Introduction Part I

The first step to come to a design for a carefully selected improvement opportunity involves the identification of the issues related to IMLOG’s LLP concept for PRODA. This will be main topic of interest in the first part of this report. The first four design problem questions will be used to structure the process of identifying issues.

First an understanding of the LLP concept in general must be created before issues can be identified. For this literature research based on the index search method (see Doorewaard & Verschuren (2005)) is applied. Furthermore it is important to understand IMLOG’s interpretation of the LLP concept in practice, where the application of the concept for PRODA serves as a perfect example. Observation, document research and interviews were applied to create this practical understanding. Based on these two sources of knowledge two different types of issues can be identified: issues based on the confrontation of literature and practice and issues solely based on practice. Within issues based on practice a distinction is made between issues related the soft aspects and the hard aspects of the LLP concept. Figure E provides insight the types of issues that can be derived from literature and practice.

According the general introduction the LLP concept can be classified as a logistics service concept. Therefore this parts starts with a general description on logistics in the business environment. This included the function of logistics, logistics relationships, logistics partnerships, logistics performance measurement and how logistics services are delivered.

The following chapter goes more into detail on the LLP concept by positioning it between other existing logistics service concepts. Based on the positioning between other logistics service concepts, the LLP concept is described according different characteristics: the key success factors. Pitfalls encountered during operating a LLP concept are identified as well. The key success factors and pitfalls will service as input to determine to which extend IMLOG fulfils the profile of a LLP according to literature.

The third chapter provides insight in IMLOG’s interpretation of the LLP concept, which they provide for PRODA. First an introduction is given on the need for a LLP concept from PRODA’s perspective, followed by a short description of the development process and several contractual facts are mentioned. Next the services provided within IMLOG’s LLP concept for PRODA are identified, as the organisational structure of IMLOG’s LLP department is explained. The last part of the third chapter goes in more detail on the operations behind the logistics services provided.
Determining to which extend IMLOG fulfils the LLP profile according to literature is the main topic of interest in chapter four. First, the level of the partnership between IMLOG and PRODA within the LLP concept is determined. Followed by checking to which extend the key success factors and pitfalls identified in literature are applicable to IMLOG’s LLP concept for PRODA. This will result in concept issues.

In the last chapter soft and hard aspect issues will be identified: these are relationship issues, service fulfilment issues and business process issues.
1 Essence of logistics in business

1.1 Creating value through logistics: where and how?

Due to a natural mismatch between supply and demand of a certain product in a specific geographical area, a need for logistics is created. This is where logistics enters the field: logistics enables to balance the supply and demand in a market. In other words; a LSP relates the seller and the buyer of products thru its logistics services (Huemer, 2006). The buyer, the seller and the LSP together form a so called logistics triad (Stefansson, 2006). Within this logistics triad a LSPs creates value for both the seller and the buyer of the product by having the product at right place (place utility) and at the right time (time utility) (Coyle et al., 2003). Stable and Fjeltstad (1998) go in more detail on how those LSP creating value thru their activities by using a value network model. Their model is based on Porters generic value chain model (Porter, 1985) and makes a distinction between the LSP’s primary and support activities. Primary activities are directly related to the LSP’s logistics services executed on behalf of the customer and involve mostly transportation, warehousing and all related physical activities. These primary activities involve as well coordination of the logistics services executed and other services like Vendor Managed Inventory et cetera. Support activities play a crucial role in the execution of the primary activities. Examples are the information system, ICT, human resources management, accounting, controlling et cetera.

Creating value by a LSP can be viewed from a supply chain perspective as well. A LSP is involved in the activities between the different fixed locations in the supply chain. Figure 1.1 shows a part of a supply chain where the production location is the central location. The plant on this production location needs raw material to produce finished products. Therefore raw materials are sourced from the sourcing location and LSP provide services to ship the raw material from the source location to the production location. The same counts more-a-less for the finished products that have to be shipped to buyer: the client location. Please be aware that a supply chain in reality can consist out of more than three locations, where one company’s client location is another company’s source location.

![Figure 1.1 - LSP involvement in the supply chain](image)

1.2 Outsourcing logistics towards a successful relationship

Depending on the situation a company can decide to execute all their logistics (primary and support) activities by themselves or to outsource one of more logistic activities. A crucial question is what motivates a customer to outsource logistic activities? Four different types of factors that influence the decision to outsourcing of logistic activities are mentioned in literature (Rushton & Walker, 2009; Bozarth & Handfield, 2006; Berglund et al, 2000; Lambert et al, 1996; Razzaque & Sheng, 1998):

1. **Organisational factors**: by outsourcing logistics activities a customer is able to focus more on their core business or core competences. In addition by using a LSP for logistics activities the customer has access to wider knowledge.

2. **Financial factors**: outsourcing logistic activities has a positive effect on capital costs, because the LSP takes over these costs. Maybe the most interesting point for customers to outsource their logistics activities is that the costs incurred change from fixed to variable which allows better allocation of logistics costs.

3. **Services factors**: in general outsourcing of logistics will lead to improved services through greater flexibility for the customer, more frequent delivery and the provision of value-added services by the LSP.
4. **Physical factors**: the complexity of supply chain structure could be best planned by LSPs, which has the experience and the control of the element in a particular supply chain structure. The need to relocate logistics facilities can also be an opportunity to outsource. It depends from company to company and the business areas they operate in which of the factors are rated with high importance.

In case of logistic activities being outsourced a LSP will be involved for the execution of these activities: a relationship comes into existence. According Brummelman et al. (2003) a logistics collaboration relationship involves three main characteristics: objective, horizon and scope. The objective gives insight in the motives of the customer to outsource certain logistics activities. The horizon within logistics collaboration covers the period length wherein the logistics services are being provided by the LSP to the customer. The scope within logistics collaboration between a customer and a LSP related to which extend a LSP is involved in the business of the customer: the level of outsourcing. The relationship between a LSP and its customer can vary in its form from pure transactional to pure relational, as suggested in figure 1.2. This diagram is initially framed for logistics relationships in general, but can also be explained from a LSP and customer perspective.

![Figure 1.2 - Logistics Relationship spectrum, adapted from Coyle et al (2003) and Lambert et al (1996)](image)

A vendor type relationship exists when there is no or little integration or collaboration between the customer of the product and the LSP: they keep an “arm’s length” distance from each other. The customer purchases the logistic services from the LSP when it is demanded without any further activities. The partner type relationship involves a certain level of collaboration between the customer and the LSP. Lambert et al (1996) provides the essence of a partnership: “A partnership is a tailored business relationship based on mutual trust, openness, shared risk and shared rewards that yields a competitive advantage, resulting in business performance greater than would be achieved by the firms individually.” (Lambert et al, 1996)

A partnership can differ in duration, strength and closeness which results in three different types of partner relationships: operational, coordination and strategic (Visser, 2007). Key characteristics of an operational partnership are short term, limited coordination and it involves often only one functional area. A coordination partnership is more focussed on coordination and integration between the customer and the LSP, but for a limited time period (mid-term). The strategic relationship has a natural character where both parties are willing to change their business to improve the performance of both. The results in the fact that the focus in this type of relationship is on further going integration and it has long term character. Thru this relationship uncertainty is reduced, loyalty increased and a common vision is established. High switching costs are the result of heavy resources commitments from both parties (Coyle et al, 2003; Hertz, 1993).

Based on different factors a customer can outsource one or more logistics activities to a LSP with the underlying purpose to be highly successful. Unfortunately it does not tell about which factors make this outsourcing relationship, partnership successful. Davydenko (2007), Berglund et al (2000), Bajec
(2005), Ackerman (1996), Razzaque & Sheng (1998) and Tate (1996) did research on the critical success factors of a logistics partnership and found the following:

- **Selective matching**: Corporate cultures and values of both the customer and the LSP are compatible.
- **Information sharing**: Information on operational, tactical and strategic levels is openly shared between the LSP and its customer.
- **Role specification**: A clear definition of the role and corresponding responsibilities for the LSP and the customer.
- **Strong performance orientation**: Thru a bonus and/or penalty system commitment and service improvements are being stimulated.
- **Ground rules**: Clear specification of business structure, risks, processes, procedures and policies within the partnership.
- **Exit provisions**: Motives on terminating the partnership and the method to be used when termination is agreed by both the customer as the LSP.

### 1.3 Measuring partnership success thru performance measurement

Success is a highly subjective term: the meaning of it differs from person to person. According to Lambert et al (1996) success of a partnership involves to what extend expectations are met. This is measured thru quantitative and qualitative success factors. Quantitative success factors are directly measurable and have a direct relation with the performance of services provided. Qualitative success factors are not easy to measure and are more related to the “soft” aspects of a partnership. Those qualitative success factors are influences by the performance of the services provided thru the quantitative success factors. The relation between the factors in success measurement and the logistics services provided is displayed in figure 1.3.

![Success measurement framework](image)

To be in a good relationship with the customer, a LSP has to satisfy the customer according its needs. In logistics, satisfaction and value for the customer is most of the time created by creating place and time utility thru services provided by the LSP (Coyle et al, 2003). These services having attributes called the “seven Rs”. The service provided should involve the right quantity of the right product at the right place at the right time in the right condition at the right price with the right information (Flint, Kent, & Mentzer, 1999). The quality of the services provided by a LSP depends on how well the services perform on these attributes. The level of satisfaction depends on the customer’s perception of the quality of the services provided and therefore the performance of the service has to be measured (Flint et al, 1999). Performance measurement can be described as a process that identifies to which extend a LSP is able to satisfy the customer. For this process criteria, performance
indicators, and target values are used to scale the performance level of the services provided. Different types of performance indicators can be identified.

A first distinction can be made between performance indicators related to the internal processes of the LSP and the performance indicators involved the services provided to the customer (Cheng et al, 2002; Krauth et al, 2005). The first type is being used with internal performance measurement where the latter is used with external performance measurement. The performance indicators related to internal performance measurement are mainly costs and assets based, external performance measurement is more focussed on supply chain reliability and flexibility and responsiveness (Cheng et al, 2002). Internal performance indicators can be divided in different types as well: effectiveness, efficiency, satisfaction and IT & innovation (Krauth et al, 2005; Flint et al, 1999). Effectiveness describes to what extent a LSP was capable of fulfilling the customer’s need. Efficiency tells something about which and how much resources are used for providing the services. Satisfaction gives insight in how people in the organisation perceive the job they are fulfilling. IT and innovation is related to the internal performance in the future. Improving the LSP’s performance requires change which can be facilitated thru IT and innovation.

Performance measurement, internal and external, requires information generated by the services provided by the LSP. Without proper information it is not easy to measure the performance of the services provided. Therefore IT and the information system of a LSP are crucial for performance measurement (Ellinger et al, 1997; Krauth et al, 2005; Vaidyanathan, 2005; Davydenko et al, 2007).

1.4 Delivering logistics services

The main goal of providing logistics services by LSPs is having the product at the right place at the right time. Fulfilling this goal can be seen as a process which starts with a logistics service request from the customer (buyer or seller of the product).

![Diagram](image)

The diagram in figure 1.4 displays in a generic way this process, represented by a block. The service request, which initiates the processes, is represented by an ingoing arrow. The output of the process is the logistics service which can be recognised as an outgoing arrow. The diagram shows two other arrows as well: coordination mechanisms and resources. The coordination mechanisms prescribe how the process of providing the logistics services should be executed, where resources are used for the execution of the process. For coordination mechanisms, resources and logistics service delivery
examples are stated as well in the diagram of figure 1.4. The following paragraphs will elaborate on the process coordination mechanisms, the resources and the logistic service.

1.4.1 Logistics services
As stated before the primary activities of a LSP are directly related to the logistics services it provides for its customer. Different type of classifications can be used for describing all logistics services provided by LSPs. Berglund et al (2000) identify four key activities related to the services provided by LSPs: transportation, warehousing, value-added logistics and information services. Within these four key activities a distinction can be made between activities which can be classified as physical logistics services and administrative logistics services (Stefansson, 2006). The first three key activities are considered to be physical logistics services, where information services are administrative logistics services.

1.4.2 Resources
To provide logistics services LSP uses strategic logistics resources. Five different types of strategic logistics resources can be identified (Karia & Wong, 2009):

- **Physical resources**: trucks, containers, warehouses, pallets etc.
- **Human resources**: (highly) skilled employees
- **Information resources**: information system capabilities
- **Knowledge resources**: expertise and know-how
- **Relational resources**: long term contracts with customers, supplier etc.

Within these five types of strategic logistics resources a distinction can be made between resources with a tangible and resources with an intangible character. Physical and human resources can be identified as tangible resources, where the other four resources are intangible. Karia & Wong (2009) prove in their paper that the use of tangible and intangible resources is close related. Without intangible resources tangible resources cannot perform at an acceptable level. In addition, they show that different strategies of bundling resources lead to different business performance levels. Five different main resource bundling strategies are identified by them:

1. Acquire resources and integrate them quickly
2. Develop information system to integrate resources and activities with customers and suppliers
3. Establish an asset (resource) management unit
4. Complement the value of a resource with another resource
5. Disposal of less strategic resources

The five different types of strategic logistics resources are not only crucial for the execution of the execution of logistics services, but are identified as crucial requirements in logistics service innovation as well (Chapman et al, 2003)

1.4.3 Coordination mechanisms
To provide logistics services to its customer a LSP executes certain processes that results in the delivery of these processes. Exchanges, which generate different types of flows, are related to these processes. Four different types of exchanges can be identified: information, products/services, financial and social exchanges (Ford, 1990; Coyle et al., 2003; Huemer, 2002). With executing these processes the different flows have to be co-ordinated to succeed in providing the logistic services. Here coordination refers to “the pattern of decision making, communication and interactions among logistics network members, which helps to plan, monitor and align the multiple flows associated with the exchanges of materials, components, services, information, money, people, and ideas, supporting the key business processes” (Romano, 2003). This definition shows in essence of what the function of a LSP is in logistics business.
1.5 Concluding remarks on the essence of logistics in business

This first chapter described several general characteristics of logistics to create understanding on the environment LLP is part of. First the function of logistics and the way logistics create value for business is discussed. Following, motives for outsourcing logistics are discussed, where the level of outsourced activities determines the relationship intensity between a LSP and a company. Critical success factors of a partnership are identified as well. The level of partnership success is depending on qualitative and quantitative performance factors, where the logistics services provided form the base. The last topic in this chapter elaborates on how logistics services are being delivered. This process starts with a request from a company. Depending on the type of logistics service request certain resources are deployed and coordination mechanisms are applied to deliver the service requested.
2 The unique potential of the LLP concept

2.1 Positioning the LLP concept among other logistics service concepts

The LLP concept IMLOG operates for PRODA is the main topic of interest in this report. In essence the LLP concept is a form of collaboration between a LSP and its customer from a logistics perspective. The LLP concept takes into account logistics activities that the customer has outsourced to a LSP. The main characteristic of the concept is IMLOG functions as a one-stop-shop for its customers concerning logistics needs. This description gives mainly insight in the number of parties a customer uses for their logistics. The Council of Supply Chain Management Professionals (CSCMP) describes by use of a definition the essence of an LLP, which will be adopted in this project:

"An organization that organizes other 3rd party logistics partners for outsourcing of logistics functions. An LLP serves as the client’s primary supply chain management provider, defining processes and managing the provision and integration of logistics services through its own organization and those of its subcontractors" (Vitasek, 2010)

Taken this definition into account the relationship between a LSP and its customer can be seen as a relationship on a partner level, due to the heavy involvement of the LSP in its customer’s business. In general a LLP provides its logistics services in a same way a LSP provides its services, see the first chapter of this report.

Rushton and Walker (2009) use another approach in defining a LLP. They propose that a LLP is a hybrid between the operational 3PL and 4PL responsibilities: the LLP concept tries to combine best of both concepts. This will be the starting point of defining a LLP in a broader sense. First step is to relate 3PL and 4PL to other types of Party Logistics. Table 2.1 gives an overview of the different types of Party Logistics including their logistics function in the business. With an increase in the number corresponding to the Party Logistics, the integration between the LSP and its customer increases. This leads as well to an evolvement of the relationship between the LSP and its customer from pure transactional towards relational. According the definition of a LLP by Rushton and Walker a LLP is involved somewhere between the management of complex service chains and the management of the whole supply chain.

<table>
<thead>
<tr>
<th>Part Logistics type</th>
<th>Business involvement</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1PL</td>
<td>In-house logistics</td>
<td>Operation of logistics by producer</td>
</tr>
<tr>
<td>2PL</td>
<td>Asset based logistics</td>
<td>Traditional transport and warehousing management</td>
</tr>
<tr>
<td>3PL</td>
<td>Forwarding/contract based logistics</td>
<td>Management of complex logistics service chains</td>
</tr>
<tr>
<td>4PL</td>
<td>Supply chain management</td>
<td>Management of the whole supply chain</td>
</tr>
<tr>
<td>5PL</td>
<td>E-Business</td>
<td>Management of all parties of the supply chain in conjunction with e-business</td>
</tr>
</tbody>
</table>

Instead of making a classification on Part Logistics types based on the involvement in the type of logistics activities, Hertz and Alfredsson (2003) propose another approach. This approach involves classification of Part logistics types based on two characteristics: the general ability of problem solving and the ability of customer adaptation. The 1PL scores low on both characteristics, where a 2PL has low problem solving abilities but with a high ability of customer adaptation. A 3PL is characterised by both high customer adaptation and problem solving abilities, where a 4PL has a high ability of problem solving, but involves less customer adaptation abilities.
Based on using general ability of problem solving and the ability of customer adaptation, Hertz and Alfredsson (2003) distinguish four different types of 3PL:

- **Standard 3PL provider**: This type of LSP provides the basic standardised logistics services to its customers. These services involve warehousing, distribution etc.
- **Service developer**: The service developer is focused on creating economies of scale and scope by providing the customer standardised logistics activity modules. In this way the service developer is able to fulfil the customers logistics needs.
- **Customer adapter**: The customer adapter can be described as a 3PL that takes over the existing logistic activities of the customer. There is a focus on the improvement of the activities’ efficiency, but no development of the service itself occurs.
- **Customer developer**: This type of 3PL is the most advanced one due to the high ability of problem solving and customer adaptation. Within the role of a customer developer a LSP takes over not only the physical logistics of the customer, but also the management of these physical logistics. This involves a high level of integration between the 3PL and the customer’s business. This enables a customer developer to improve the efficiency of the logistics activities next to the possibility to improve the services itself thru re-design.

Following the definition of the CSCMP the LLP should have a high general ability of problem solving thru integration and design of services compared to the other Party Logistics types. In addition the LLP should also be able to take over logistics activities from the customer, which makes a LLP having a high ability of customer adaptation. Taking these characteristics into account a LLP shares most similarities with a customer developer according the differentiation between different 3PL types by Hertz and Alfredsson (2003).

Taking the current practices of 3PL into account, it can be recognised that 3PLs are fulfilling not solely one function but trying to fulfil multiple functions. This causes greater competition between 3PLs (Ojala et al, 2006). Therefore the conclusion can be made that it is hard to define exactly a specific set of functions a certain 3PL fulfils; it differs from company to company.

### 2.2 Recognising a LLP by its critical success factors

Extensive literature what exists on the 3PL and 4PL concept is not been written for the LLP concept. Therefore no set of characteristics, through which a LLP can be described, is found by the author. From the previous paragraph can be concluded that the LLP concept has characteristics from both the 3PL and 4PL concept. This enables to form a list of LLP characteristics, derived from the characteristics of the 3PL and 4PL concept. First step is to determine the factors through which characteristics of the 3PL and 4PL concept can be described. These factors are derived from literature written by Win (2008), Rushton & Walker (2009) and Huemer (2006). Characterising the 3PL and 4PL concept based on these factors is performed by using literature of Win (2008), Rushton & Walker (2009), Huemer (2006), Stefansson (2006) and Marasco (2008) and conducting interviews among chemical producing companies (company and contact person are known by the author). Based on the assumption that a LLP is a hybrid between the operational 3PL and 4PL responsibilities, characteristics of a LLP are determined based on those of the 3PL and 4PL concept. The LLP can either fully adopt a 3PL characteristic or a 4PL characteristic. Additionally it can occur that the LLP characteristic is a merge of a 3PL and 4PL characteristic. Table 2.2 shows the characteristics of the 3PL, LLP and 4PL concept based on the factors identified from literature.

In absolute numbers can be concluded that the 3PL adopts as many characteristics as the 4PL concept. Also for two characteristics, physical resource usage and operational business area, the LLP concept combines both characteristics for the 3PL and the 4PL concept. Based on the LLP characteristics mentioned in table 2.2 can be determined to what extend a LSP fulfils the role of a LLP. Therefore these characteristics will serve as the key success factors of a LLP concept.
Table 2.2 - LLP characteristics based on 3PL and 4PL characteristics

<table>
<thead>
<tr>
<th>Factor</th>
<th>3PL</th>
<th>LLP</th>
<th>4PL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset basis (Win, 2008)</td>
<td>Heavy asset based</td>
<td>Heavy asset based</td>
<td>Light asset based (IT systems)</td>
</tr>
<tr>
<td>Accountability (Win, 2008)</td>
<td>Part (in conjunction with</td>
<td>Total singular accountability (as if internal)</td>
<td>Total singular accountability (as if internal)</td>
</tr>
<tr>
<td></td>
<td>internal resources and/or other 3PLs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Role (Win, 2008)</td>
<td>Logistics (typically)</td>
<td>Logistics, supply and demand chain integration</td>
<td>Logistics, supply and demand chain integration</td>
</tr>
<tr>
<td>Business impact (Win, 2008)</td>
<td>Influences time and place utilities</td>
<td>Influences time and place utilities</td>
<td>Controls time and place utilities, but also influencing form and possession utilities</td>
</tr>
<tr>
<td>Physical resource usage</td>
<td>Maximise use of own assets</td>
<td>Maximise use of own assets in combination with third party equipment if needed</td>
<td>Only through resources of third parties</td>
</tr>
<tr>
<td>Physical resource usage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Rushton &amp; Walker, 2009)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance/success measurement (Win, 2008)</td>
<td>Cost</td>
<td>Value creation within customer organisation</td>
<td>Value creation within customer organisation</td>
</tr>
<tr>
<td>Operational business area</td>
<td>Vertically across the supply chain</td>
<td>Vertically and horizontally across the supply chain</td>
<td>Horizontally across the whole supply chain</td>
</tr>
<tr>
<td>(Huemer, 2006)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply chain involvement</td>
<td>Execution of elements in the supply chain</td>
<td>Execution of elements in the supply chain</td>
<td>Supply chain wide involvement (providing end-to-end solutions)</td>
</tr>
<tr>
<td>(Huemer, 2006)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perspective (Rushton &amp; Walker, 2009)</td>
<td>Own perspective (not neutral)</td>
<td>Own perspective (not neutral)</td>
<td>Shipper’s perspective (neutral)</td>
</tr>
<tr>
<td>Exclusiveness (Rushton &amp; Walker, 2009)</td>
<td>One of many LSPs</td>
<td>Single point of contact</td>
<td>Single point of contact</td>
</tr>
</tbody>
</table>

2.3 Pitfalls when operating a LLP concept

The intention of a logistics partnership is to be successful, whereby its success can be measured during the execution of the partnership or afterwards thru an evaluation. As the LLP concept shares a lot of similarities with 3PL it makes sense to go in more detail on the structural issues related to the 3PL concept. By knowing these structural issues it can determined to which extend the LLP concept is able to solve these structural issues. Also structural issues related to the 4PL concept can be considered. Due to the fact that 4PL is a relatively young concept, no significant structural issues involved with the LLP concept are known in literature. Therefore only the structural issues involving the 3PL concept will be taken into account. The structural issues are identified from literature of Rushton and Walker (2009), House and Stank (2001). Interviews conducted with several chemical producing companies confirm these structural issues (names of the companies and contact persons known by the author). The following structural issues related to the 3PL concept are identified as a lack of:

- **A total supply-chain perspective in a Pan-European and global context**: according its customer 3PLs are nowadays too much focussed on just the links with a supply chain instead of the supply chain as a whole consisting out of multiple nodes and links. Related to these issues is the absence of real true pan-European and global 3PL which can manage, control and execute all logistic activities themselves on a European or a global scale.
• **Visibility along the supply chain**: for most of the 3PL its customer’s logistics are still a “black” box. The more logistics activities are outsourced, the bigger the need for information on these activities from the customer becomes. For instance the customer wants to know where its products are and when, how the products are going to be delivered. In short the customer wants to know how you deal with his logistics needs. By sharing more logistics activities information an improved mutual understanding of (each other’s situation in) the partnership can be obtained.

• **Measurement along the supply chain (cost and performance)**: related to the previous issues is performance measurement. Performance measurement is relying on information of the logistics activities executed on behalf of the customer. Performance measurement date could provide the right information to identify improvement opportunities.

• **Open system**: in general 3PLs are closed systems which contribute to the fact the customers seeing the logistics activities performed by a 3PL as a black box.

• **Lack of IT support and commitment**: this issue involves the opinion of a 3PL involving the question how technique could support logistics in the future. In general there is a lack of IT development specifically related to logistics services provided by 3PLs.

• **Flexibility**: flexibility has a major influence on the quality of the partnership perceived by the customer. By being more flexible a 3PL should have fewer problems in satisfying the customer. In a situation when flexibility is requested from the 3PL, nowadays it is likely that a customer will be disappointed in its initial need.

• **Tailored structures and system**: currently 3PL operate a specific set of logistics services. In a situation where a customer has a specific logistics need, current operated logistics services serve a starting point. Sometimes these logistical services should be adapted to the customer’s wishes and needs to achieve the best performance. Due to the fact that these services are not tailored to the customer’s situation a sub-optimal performance of the services provided.

• **Pro-activity**: With solving these structural issues a pro-active behaviour and attitude is crucial, but is missing among many 3PLs. The missing pro-active attitude is the result of a vicious circle where LSP is in, see general introduction.

### 2.4 Concluding remarks on the unique potential of the LLP concept

This chapter focused to give an interpretation of the LLP concept from a theoretical perspective. Therefore the LLP concept was first positioned between the other Party Logistics. It can be concluded that the LLP concept is a hybrid between an operational 3PL and the 4PL responsibilities. Based on this position characteristics of the LLP concept are derived from the 3PL and 4PL concept, where the LLP concept inherits from the 3PL and 4PL concept each fifty percent of its characteristics. In two LLP characteristics, the characteristics of the 3PL and 4PL concept are combined. These LLP characteristics together are identified as the critical success factors of the LLP concept. Operating the LLP concept should also contribute in relieving the logistics business from currently experienced issues. Therefore a set of structural issues was formulated, where structural issues can also be classified as pitfalls when operating the LLP concept. The critical success factors and pitfalls identified will be used to determine to which extend IMLOG’s LLP concept matches the LLP concept profile from a theoretical perspective.
3 A tailored logistics solution for PRODA

This chapter will provide insight in the LLP concept IMLOG provides for PRODA. First an overview is given on the preparatory activities before the concept became fully operational. Project document research was applied to create this overview (documents are known by the author). Following an overview of the logistics services provided within IMLOG’s LLP concept for PRODA is given. The processes responsible for delivering the logistics services to PRODA are elaborated as well. This chapter ends in a description of the organisational structure concerning IMLOG’s LLP concept for PRODA. For the identification of the logistics services with the underlying process observation and interviews within IMLOG are applied.

3.1 Need and development process resulted in a tailored LLP contract

In January 2008 PRODA started to search for a structural European distribution solution for their bulk liquid products. In a Request For Information (RFI) in combination with a questionnaire PRODA asked several LSPs to develop a European distribution strategy. This strategy should take road and intermodal transport into account and should cover measures to handle upcoming challenges for distribution in the chemical industry. The main challenges involve the growing road congestion on the European road network, the growing truck driver shortage and carbon dioxide reducing initiatives. The operating period for the distribution strategy will take five years into account: from January 2009 until January 2014. Tree core objectives are involved with operating a LLP concept for PRODA: to reduce overall costs, to improve customer service and to improve the sustainability of the supply chain as a whole (Seifert, 2009). Last point of interest is the question from PRODA how to accommodate expected growth of sales in the east.

Developing a tailored LLP solution like IMLOG did for PRODA is not an easy task. An extensive process of identifying needs and constraints and developing a solution accordingly was needed. This process has taken almost a year before the concept was fully operational: The milestones within the development process of the LLP concept for PRODA are stated in table 3.1.

| Table 3.1 - Milestones in LLP concept development (source known by the author) |
|-----------------|-----------------|-----------------|
| Month           | Year            | Subject                      |
| January         | 2008            | Concept presentation following the Request For Information |
| June            | 2008            | Clarification meetings on concept presentation |
| July            | 2008            | Final concept presentation following the Request For Proposal |
| August          | 2008            | IMLOG chosen as LLP |
| September       | 2008            | Prepare and implementation of the LLP concept |
| January         | 2009            | Operational launch of the LLP concept |

With operating this kind of concept a contract is developed as well. The contract consists mainly out of jurisdictional clauses and operational instructions. It would be too much to elaborate in detail on the contract. Nevertheless several interesting facts on the development process and the contract which should be mentioned in this report (source known by the author):

3.1.1 Statements by IMLOG during development process
3.2 Logistics services provided by the LLP concept

From a high level perspective the main function within LLP concept is taking care of the logistics needs of PRODA. The concept is responsible for making the arrangements for each logistics activity and the related execution of these logistics activities. These two functions can be identified as main primary functions according the value network model of Stabell and Fjeldstad (1998). The process of providing and delivering the logistic services within IMLOG’s LLP concept are organised according the basic process model.

The logistics services provided within the LLP concept can be divided according Stefansson (2006) into two types: physical logistics services and administrative services. Physical logistics services involve the execution of the logistic activities, making the arrangements for these logistics activities are typically an administrative function. Making the arrangements is necessary before the logistics activity can be executed. This shows that physical and administrative logistics are complementary services.

The physical logistics services provided by IMLOG thru its LLP concept for PRODA involve mainly transport of liquid bulk chemical by use of tank load units. Storage of products in containers is offered within IMLOG’s LLP concept as well but incidentally. Container cleaning is an additional
service offered within the concept as well. Container cleaning is applied when re-loading of a container is not allowed or on customer wish. Two different types of transport services are offered: **intermodal** and **road transport**. Figure 3.1 gives a representation of the activities that are involved with the intermodal transport chain. It shows as well that road transport (further on mentioned as intermodal road transport) is necessary for pre- and post- transport within intermodal transport. If the situation requires the load unit is stored during the transhipment of the load unit. The load unit is in that case temporarily stored on the terminal where the transhipment takes place. Within IMLOG’s LLP concept for PRODA the loading location and the unloading location are responsible for unloading the shipment.

Next to intermodal transport IMLOG provides within the LLP concept for PRODA single mode transport by road as well. Figure 3.2 shows which activities are involved with this type of transport. The absence of the transshipment activity in the road transport activity chain implies that intermediate storage of the load unit does not occur in general; although there are exceptions. As is the case with intermodal transport, with road transport loading and unloading the shipment are the responsibility of the loading and unloading location.

As mentioned in the description of IMLOG’s LLP concept for PRODA in the general introduction of this report, IMLOG operates the LLP concept for PRODA in collaboration with LLP transport partners. The companies that fulfil a LLP transport partner role in the LLP concept are stated in appendix A. The LLP transport partners are involved with both intermodal and road transport depending on the product to be shipped and the loading location. Within this collaboration IMLOG has a leading position, because it is the main contact point for PRODA. In addition IMLOG is in the end responsible for the services provided by its own organisation and the LLP transport partners. Therefore a management of the LLP transport partner is necessary. **LLP transport partner management** can be identified as an administrative logistics service.

Concerning the intermodal and road transport for which IMLOG is responsible within the LLP concept for PRODA, IMLOG takes care of the arrangements to be made. In practice a distinction is made between short and long distance road transport, where short distance and intermodal road transport is mainly outsourced to IMLOG subsidiaries. Making the arrangements involving the transport activity chain, which is an administrative logistics service, will be mentioned further on as **transport chain coordination**.

Next to the three above mentioned fundamental administrative logistics services IMLOG provides within its LLP concept for PRODA a payment portal. This payment portal results in a situation that PRODA will only be charged by IMLOG for the services provided by IMLOG and the LLP transport partners. In this case IMLOG will be charged by the LLP transport partners and is responsible for the payments involved.

Another administrative logistics service provided within IMLOG’s LLP concept for PRODA is extensive track and trace. A daily manually executed process within the concept tracks and traces all shipments including their status and location. In this way the customer is guaranteed of information on the
situation and proceeding of the physical logistics services. Thru this service IMLOG, PRODA and its clients are able anticipate on the situation in case of problems.

The last, but not less important, administrative logistics service provided is optimisation and integration within the LLP concept. Optimisation relates to performance improvement of current practices while integration involves the development and implementation of new logistics services within the LLP concept. Those “new” services could be existing services tailored for PRODA or services especially designed with a special purpose within the LLP concept.

It can be mentioned that no value-added services are provided within IMLOG LLP concept for PRODA. With value-added services are service meant that add a significant additional value to the product being transported (Rushton & Walker, 2009).

All service provided by IMLOG in the LLP concept for PRODA are summarised in table 3.3. Besides those services, IMLOG provides several other logistics services for its customer: further information on IMLOG’s total set of logistics service can be found in appendix B.

### Table 3.3 - Services provided by IMLOG’s LLP concept for PRODA

<table>
<thead>
<tr>
<th>Physical logistics service</th>
<th>Administrative logistics service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation</td>
<td>LLP transport partner management</td>
</tr>
<tr>
<td>Transhipment</td>
<td>Transport order coordination</td>
</tr>
<tr>
<td>Storage</td>
<td>Transport chain coordination</td>
</tr>
<tr>
<td>Container cleaning</td>
<td>Payment portal</td>
</tr>
<tr>
<td></td>
<td>Track &amp; trace</td>
</tr>
<tr>
<td></td>
<td>Optimisation / Integration</td>
</tr>
</tbody>
</table>

3.3 Coordination & execution of the LLP logistics services

With its physical resources IMLOG is only able to execute single mode road transports and the road transport involved with intermodal transport. The transhipment of the load units can be performed by IMLOG subsidiaries terminals. Depending on the situation terminals of third parties could be used for this if necessary. These third party terminals, the rail operators and shipping lines involved in intermodal transport are responsible for the execution of the specific logistic activities within the intermodal transport activity chain. They will be mentioned further on as intermodal transport partners. Regarding the container cleaning service offered within the LLP concept for PRODA, IMLOG is able to clean the containers at subsidiaries. Depending on the situation third party cleaning stations will be used for cleaning the containers. This third party container cleaning station will be mentioned further on as container cleaning partners. Planning activities are necessarily involved with the execution of these physical logistics services. These functionalities together will be mentioned further on as planning & execution.

Table 3.4 concludes with representing the parties that are involved with the coordination and execution of road and intermodal transport. In the case a LLP transport partner takes care of a shipment order, it is responsible for both the transport chain coordination a planning and execution of the transport.

### Table 3.4 - Involvement parties in types of transport

<table>
<thead>
<tr>
<th>Modality</th>
<th>Transport chain coordination</th>
<th>Planning &amp; execution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td>Short distance &amp; intermodal road</td>
<td>IMLOG LLP department, LLP transport partners</td>
</tr>
<tr>
<td></td>
<td>Long distance</td>
<td>IMLOG LLP department, LLP transport partners</td>
</tr>
<tr>
<td>Intermodal</td>
<td></td>
<td>IMLOG LLP department, LLP transport partners</td>
</tr>
</tbody>
</table>

3.3.1 Order flow

To gain a better understanding on how coordination and execution of the transport orders are being handled, an order flow analysis is applied. Figure 3.3 displays the highest flow level of an order. First
the transport order is received by IMLOG’s LLP department by EDI (Electronic Data Interchange). The next step is distributing the transport orders between IMLOG and the LLP transport partners. In a preceding step the orders are entered into IMLOG’s information system and additional related information is added to the order. This process in total is described before as transport order coordination. The next step is processing the transport order is to plan and execute the transport. Based on a successful transport execution an invoice is generated and send to the customer. After the invoice is paid, the transport order is concluded and will be terminated.

The generally known INCOTERMS (Ramberg, 1999) are applied to all transports IMLOG provides PRODA by its LLP concept. Most of the shipments are performed under Delivered Duty Paid (DDP) where the shipper bears the risks and costs for the transport from the loading point up until the customer. In some instances shipments are executed under Delivered Duty Unpaid (DDU) where the shipper bears the risks and costs for the transport from the loading point up until the customer, excluding import taxes. The customer will pay for these taxes. Occasionally products are loaded and shipped to storage locations of PRODA: these transports are performed under Ex Works (EXW). In this case PRODA bears both the risks and costs related transport from the loading location up until the storage location.

Besides IMLOG itself, LLP transport partners are involved with the coordination, planning and execution of the transport orders. When transport orders are taken care of by LLP transport partners, IMLOG is still responsible for the execution of those orders towards PRODA. Therefore IMLOG’s LLP
department tracks and traces the transport orders handled by LLP transport partners to be able to guarantee PRODA the execution of those transport orders. Transport orders IMLOG’s LLP department is related to involve another type of the coordination, planning and execution process depending on the mode(s) used for transport. Figure 3.4 shows the activity chains of the coordination, planning and execution process for each type of transport.

A few important remarks have to be made when obtaining a clear understanding of the different activity chains of coordination, planning and execution. First, short and long road transports are using road tankers next to containers as load units. This is not the case for intermodal transport which involves solely the use of containers. Second, booking loading and unloading slots by IMLOG’s LLP department is only performed in the case of long distance road transport. The reason is because IMLOG’s LLP department is responsible for only for the planning and execution of this type of transport. For the short distance and intermodal transports IMLOG subsidiaries are responsible for the planning and execution of the transports and therefore have to book the loading and unloading slots.

Transport orders where IMLOG is responsible for planning and execution by use of own equipment are short and long distance road transport and intermodal road transport. For intermodal transport IMLOG’s LLP department takes care of the transport chain coordination, IMLOG subsidiaries are responsible for the planning and execution of short distance and intermodal road transport.

Further information on the involved types of liquid bulk chemicals, the loading locations and the use of tank load units can be found in appendix A.

3.3.2 Departments supporting the LLP concept

For providing the logistics services to PRODA, IMLOG’s LLP department is supported by several general departments within the IMLOG company. IMLOG’s LLP department shares the supporting services from these general departments with other disposition departments. The following departments fulfil a crucial role in the LLP concept:

- **IT department**: Shipment orders are received from PRODA thru an electronic interface, also known as EDI (Electronic Data Interchange). From the moment a shipment is received by IMLOG, the IT department is involved through the information system they are responsible for. The information system stores each piece of information that is related to the shipment order and can be subtracted from the system if needed. The IT department is responsible for the electronic interfaces through which intermodal transport partners bookings can be made.

- **Calculation department**: The price of the services provided by IMLOG can fluctuate due to changing market circumstances. The calculation department is responsible for the determination of the prices of the logistics services. In addition, this department is responsible for calculating prices of new origin-destination as well. Price information of the provided services is stored in IMLOG’s information system.

- **Invoicing department**: Payment of the services provided by IMLOG is necessary when the services are delivered. The invoice department is responsible for providing PRODA the right information (thru an invoice) related to the services delivered. Based on this information PRODA can perform the payment. The invoice department checks the status of the invoice as well. The information mentioned in the invoice is subtracted from IMLOG’s information system.

- **Technical department**: The technical department supports the LLP department on technical matter: from container specifications to unloading hoses. For instance the technical department determines which container modifications have to be to fulfil the wishes of a (new) PRODA client.

- **Quality department**: Performance measurement of the services provided by IMLOG is conducted by the quality department. The information needed for performance measurement is being subtracted from the information system. The department takes care as well of handling quality complaints by PRODA.
3.3.3 LLP actors & interfaces
As discussed before IMLOG does not operate the LLP concept for PRODA fully by its own organisation. Figure 3.5 represents how each actor is related to the LLP concept from an operational perspective. IMLOG’s LLP department fulfils a central, both coordination and execution role within the LLP concept for PRODA. The arrows in the diagram represent interfaces which exist between IMLOG’s LLP department and the involved actors. Within IMLOG’s LLP concept for PRODA numerous operational communication interfaces can be identified: interfaces which are essential in providing the logistics services to PRODA. A distinction is made between internal and external interfaces. Internal interfaces are identified between the IMLOG LLP department and other actors within the IMLOG company. External interfaces are formed between the IMLOG LLP department and the parties apart from IMLOG. Following each of the interfaces mentioned in figure 3.5 will be discussed.

![Figure 3.5 - Operational actor network related to IMLOG’s LLP concept for PRODA](image)

Figure 3.6 displays the internal interfaces between the IMLOG LLP department and actors within IMLOG. The interface between IMLOG’s LLP department and the subsidiaries involves solely transport chain coordination. E-mail, fax and telephone support the communication between the LLP department and subsidiaries. Dedicated drivers are involved with the long distance road transport, where the coordination and execution is under responsibility of the IMLOG’s LLP department. Solely telephone is applied for the communication with the truck drivers.

![Figure 3.6 - Operational internal interfaces](image)

The second group of interfaces involves the transport order coordination function within the LLP concept. This function involves the distribution of the shipment orders between IMLOG and the LLP transport partners. Figure 3.7 displays the interfaces between these three actors, including media which facilitate these interfaces. In this figure you can recognise that all communication between PRODA and the LLP transport partner runs through IMLOG’s LLP department.
Next to these internal actors, external actors play a major role in the transport chain coordination function of the LLP concept. Therefore interfaces exist between the IMLOG LLP department and external actors, see figure 3.8. First the shipment has to be loaded at one of PRODA’s production, storage or supply locations. Secondy the shipment has to be delivered at PRODA client’s site by use of road or intermodal transport. When intermodal transport is applied intermodal transport partners are involved. E-mail, fax, telephone or a web portal facilitate these three communication interfaces. When LLP transport partners are responsible for certain shipment orders a comparable situation exists concerning the interfaces between.

3.3.4 Performance measurement

To monitor and control the quality of the services provided within IMLOG’s LLP concept for PRODA, performance measurement is necessary. Internal IMLOG documentation (source known by the author) is used for creating an overview on the performance measurement structure applied in IMLOG’s LLP concept for PRODA.

Within the performance measurement a distinction is made between performance measurements related to the services IMLOG provides PRODA and the service provided by LLP transport partners. The same performance measurement structure is applied in the both situations.

Performance indicators

Within the performance measurement Key Performance Indicators (KPI) are defined, which measure the performance of the logistics services provided by IMLOG’s LLP concept on a monthly base. These KPIs are used for performance measurement of the LLP transport partners on a monthly basis as well. Based on the measured performance level PRODA is allowed to cancel the contract immediately, without any costs involved. Penalties resulting from underperformance are not taken into account in the contract (source known by the author).

<table>
<thead>
<tr>
<th>Performance insight KPIs</th>
<th>Scoring KPIs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near Misses</td>
<td>VIR – Vendor Improvement Request (35 points)</td>
</tr>
<tr>
<td>Number of shipment order amendments</td>
<td>SIR – Service Improvement Request (30 points)</td>
</tr>
<tr>
<td>Number of rush orders</td>
<td>QIR – Quality Improvement Request (10 points)</td>
</tr>
<tr>
<td>Dedicated equipment occupancy rate</td>
<td>Responsiveness on VIR/SIR/QIR (15 points)</td>
</tr>
<tr>
<td>Number of shipments</td>
<td>Underweight shipments (10 points)</td>
</tr>
<tr>
<td>Number of late deliveries</td>
<td></td>
</tr>
<tr>
<td>Late pick-ups</td>
<td></td>
</tr>
</tbody>
</table>
A distinction is made between indicators which are used for calculating the overall performance of the concept and indicators that are used for gaining performance insight. The indicators from which the performance is calculated will be mentioned as scoring KPI’s. In case of a perfect performance the score of these key performance indicators add up to 100 points. The KPI’s used for gaining performance insight do not count for the final measured performance level. Table 3.5 states these performance insight KPI’s and scoring KPI’s (including their maximum score). Appendix D provides insight in the calculation of the KPI values.

Data concerning the performance insight KPIs and the underweight shipments is derived from operational data stored in IMLOG’s own information system. VIR, SIR and QIR originate directly from PRODA and are registered by the LLP project leader. Also the responsiveness on the VIR, SIR and QIR is monitored and registered by the same LLP project leader. More information on this function within IMLOG’s LLP concept can be found in the paragraph 3.4.

**Performance meetings**

During the year several meetings are held to discuss the performance of the LLP concept. As result of these meetings corrective actions can be developed and implemented to improve performance. A distinction is made between meetings between PRODA and IMLOG and between IMLOG and the LLP transport partners. Every three months a business update meeting is organised which is attended by persons from PRODA and IMLOG. During this meeting not only the performance is discussed, but the development of the chemical market and operational issues as well. Next to these business update meetings a yearly quality strategy meeting is organised to discuss quality issues and measures to improve quality from a tactical and strategical perspective.

The performance meetings between IMLOG and the LLP transport partners are held once in the three months as well. During this meetings their performance, quality issues and situational problems are discussed.

**3.4 Organisational structure of IMLOG’s LLP department**

The main operational functions identified in IMLOG’s LLP concept for PRODA involve the coordination and the execution of short and long distance road and intermodal transport within the IMLOG company. In addition the coordination of shipment order among LLP transport partners can be classified as a main operational function as well. Based on these functions operational positions in the LLP department are formed. Also an administrator forms a part of the operational team, with as main task the transport order coordination. Intermodal and short distance road transport coordination is taken care of by the intermodal planner. The long distance road transport planner is responsible for the coordination and execution of long distance road transport. As mentioned before IMLOG is the only contact partner of PRODA where LLP transport partners are involved in the transport chain coordination and execution of shipment orders. Therefore LLP transport partners are not allowed to be in direct contact with PRODA. Operational communication between PRODA and the LLP transport partners is being facilitated thru the LLP transport partner planner.

Next to these operational positions, two positions are part of IMLOG’s LLP department from a tactical perspective: the project leader and the PRODA In-plant. These two positions are not involved with the operations on daily base, but are fulfilling a supporting role. The project leader and the in-plant are the communication partners of PRODA on a tactical level.

Strategical involved with IMLOG’s LLP concept for PRODA are liquids logistics manager and the business development manager. Both are responsible maintaining and strengthen the relationship on the long term between IMLOG and PRODA.

Figure 3.9 displays the organisational setup of IMLOG’s LLP department; a distinction is made between the positions that are involved from an operational, tactical and strategical level. Below the different position are elaborated in more detail. Operational positions will be explained thru the activities and responsibilities involved with this position.
Liquids logistics manager
The liquids logistics manager is the person that is in the end responsible for the performance of IMLOG’s LLP for PRODA. This person will only intervene in the operations in case of high emergency issues that influence the relationship between IMLOG and PRODA in a negative way. Together with the project leader and the business development manager this person handles tactically and strategical issues regarding IMLOG’s LLP concept for PRODA.

Business development manager
The business development manager is involved in the LLP concept from a sales point perspective. This person will be involved in strategical issues next to the liquids logistics manager.

Project leader
The project leader takes care of mainly non daily operational related issues regarding the LLP concept. This includes contractual agreements, performance measurement, making arrangements for new transport solutions, preparing performance meetings with PRODA and partner LSPs. Together with the PRODA in-plant the project leader is responsible for the management of LLP transport partners. Depending on the situation the project leader supports the PRODA in-plant and gives support to the liquid logistics manager on tactically and strategical issues.

PRODA in-plant
The intention with having this person at PRODA’s office is to be able to respond quickly in situations where time is a critical factor. In such situations the PRODA in-plant is involved in providing support to the operational positions: it fulfils a mediating role between IMLOG and PRODA. Together with the project leader the PRODA in-plant is responsible for the management of LLP transport partners. Other activities covered by the FLB in-plant involve supply of statistics to PRODA, check of invoices, payload optimisation and modal shift proposals.

Administrator
The main function of the administration is processing the shipment orders from PRODA, which involves the following activities:

- Enter the orders from PRODA in IMLOG’s information system by creating a shipment order profile. More information about the shipment order profile can be found in appendix C.
- Distribute the shipment orders between the different logistics service partners (see appendix E and F)
- Responsible for shipment invoices
• Create extra costs invoice related to specific shipments

**Intermodal & short distance road planner**
Besides the planning of the intermodal shipments, the intermodal planner takes care of the short distance road transport as well. The following activities are involved with this function:
• Determine the route for intermodal shipments
• Assign suitable container to the shipment
• Book capacity at intermodal partner LSPs
• Instruct IMLOG subsidiary involving pre-, post- and short distance road transport
• Track and trace intermodal and short distance road transport shipments
• Communicate with PRODA concerning intermodal and short distance road transport shipments
• Plan the maintenance on the PRODA dedicated containers

The relevant IMLOG subsidiary books loading slots at the loading station and unloading slots at the client site themselves, because they plan the pre-, post- and short distance road transport.

**Long distance road transport planner**
The long distance road transport planner takes care of the international road transports within the concept. For the execution of these transports this planner has a set of international truck drivers which are instructed directly by this planner instead of the subsidiary. The main activities involved with this function are identified as follows:
• Assign suitable container to the shipment
• Assign suitable truck including driver to the shipment
• Instruct the truck driver
• Book loading slot
• Book unloading slot
• Track and trace long distance road transport shipments
• Communicate with PRODA concerning long distance road transport shipments
• Plan the maintenance on the PRODA dedicated containers

**LLP transport partners planner**
Depending on several shipment order characteristics and circumstances a specific LLP transport partners is involved with the execution of the shipment transport (which makes it LLP transport partner in particular). In total five LLP transport partners are involved in IMLOG’s LLP concept. In most cases these shipments involves road transport, but intermodal transport occurs in some instances as well. This function can be considered more a coordination activity, which includes:
• Book loading slot
• Book unloading slot
• Track and trace shipments performed by LLP transport partners
• Communicate with PRODA concerning shipments performed by LLP transport partners
• Communicate with LLP transport partners concerning shipments

**3.5 Concluding remarks on IMLOG’s LLP concept for PRODA**
IMLOG LLP concept for PRODA stems from PRODA’s need for a European distribution structure for bulk liquid chemical products. The goal from PRODA’s perspective in the LLP concept is to reduce overall costs, to improve customer service and to improve the sustainability of the supply chain as a whole.

Two different types of logistics services are provided by IMLOG’s LLP concept; physical and administrative logistics services. Physical logistics services involve activities related to intermodal and road transport, for example transportation, transhipment, storage and container cleaning. Administrative logistics services involve LLP transport partner management, transport order and
transport chain coordination, payment provision portal, track & trace and optimisation and integration of current service provided.

Considering the logistics services provided by IMLOG’s LLP concept for PRODA, four types of transportation are being distinguished: transport executed by LLP transport partner transports, short distance road transport, long distance road transport and intermodal transport. Last three mentioned types of transport are fully coordinated by IMLOG. Additionally IMLOG responsible as well for the execution of both types of road transport IMLOG. With the provision of logistics services IMLOG’s LLP department makes use of supporting services from within the IMLOG company, for instance IT, invoicing and quality. Also the internal and external interfaces between IMLOG and PRODA, PRODA’s client, the LLP transport partners, the intermodal transport partners and the container cleaning partner are identified and described. The performance of the logistics service provided by IMLOG’s LLP concept is measured according several KPI’s. Mainly KPIs on improvement request are used for scoring, where other KPI’s serve for a monitoring purpose.

Based on the classification of the four types of transportation within IMLOG’s LLP concept, the operational organisational structure of IMLOG’s LLP concept is created. Each type of transport falls under the responsibility of one employee of IMLOG’s LLP department. In addition an administrator is part of the operational organisational structure as well. The PRODA in-plant and the project leader support the operational structure, but are more involved with IMLOG’s LLP concept from a tactical perspective. On strategic level the liquid logistics manager is in the end the responsible person for the concept, but is supported by the business development manager.
4 IMLOG: a true LLP or not?

4.1 Determination of the partnership quality
IMLOG’s LLP concept for PRODA can be characterised as a relationship between the two parties. Due to the extensive set of logistics services provided within the concept, it can be concluded that this relationship is more relational than transactional based (see paragraph 1.2). Whether IMLOG’s LLP concept for PRODA involves a partnership can be derived from to what extent IMLOG’s LLP concept for PRODA meets the partnership’s critical success factors (see paragraph 2.2):

- **Selective matching**: The development, implementation and continuous operation of IMLOG’s LLP concept for PRODA are evidence of a match between the corporate cultures and values of IMLOG and PRODA.
- **Information sharing**: Information on operational, tactical and strategic levels is openly shared, but with a focus on performance information. Intensifying the level of information sharing on each level will lead to better understanding and trust in the partnership.
- **Role specification**: IMLOG, PRODA and LLP transport partners have a clear definition of their role and corresponding responsibilities in IMLOG’s LLP concept for PRODA. Within IMLOG’s LLP department it is occasionally hard to find out which person is responsible for a certain activity.
- **Strong performance orientation**: Although IMLOG’s LLP concept for PRODA knows a strong performance orientation, a bonus and/or penalty system is not in place to stimulate performance. Only one small improvement incentive is agreed in the contract.
- **Ground rules**: IMLOG’s LLP concept for PRODA knows a clear specification of business structure, risks, processes, procedures and policies within the partnership.
- **Exit provisions**: Exit provisions are clearly agreed in the contract: PRODA is allowed to terminate the contract in case of underperformance. IMLOG is allowed to stop the provision of logistics services in case of overdue payments.

Based on the scoring on the critical success factors IMLOG’s LLP concept for PRODA can be classified as a partnership. This conclusion does not provide insight in the quality level of the partnership between IMLOG and PRODA. Lambert et al (1996) developed a framework through which the quality level of a partnership can be determined. This framework is applied to IMLOG’s LLP concept for LLP Europe; the results can be found in appendix G.

Based on the applied framework of Lambert et al (1996) it can be concluded that the partnership between IMLOG and PRODA concerning the LLP concept scores on average medium. Remarkable is that the partnerships scores high on operational related components, where a low score is obtained on relational components of the partnership. Nevertheless, there are a lot of opportunities available through which the quality level of the partnership between IMLOG and PRODA concerning the LLP concept can be increased.

4.2 Scoring on LLP critical success factors
In paragraph 2.2 critical success factors of an LLP are identified from literature on 3PL and 4PL. This paragraph will provide insight into what extend IMLOG is able to fulfil these key success factors in the LLP concept it provides PRODA. First the key success factors fully fulfilled within IMLOG’s LLP concept for PRODA are mentioned. Following, several key success factors are stated which are not fully fulfilled by IMLOG. The last mentioned key success factor is not met at all within IMLOG’s LLP concept for PRODA.

4.2.1 Full fulfilment

1. **Heavy asset based**: In fact IMLOG is heavy asset based by own terminals, trucks and container which it uses for executing logistic services. The reason for its heavy based
character can be found in history: IMLOG has organically grown as it is nowadays from a small transport company (2PL) to leading LSP specialised in chemical bulk logistics.

2. **Influences time and place utilities**: The logistics services IMLOG provides with its LLP concept for PRODA involves no change in product possession. IMLOG facilitates solely the process of possession change of the product from PRODA to its customer by having the order product at the right location at the right moment.

3. **Priority on maximising usage of own assets**: IMLOG is a heavily asset based which results in the need to optimise the use of own assets. Therefore the main focus in IMLOG’s LLP concept for PRODA is on providing the logistics services thru own equipment. Assets, equipment of third parties / LLP transport partners are used in cases where IMLOG does not have a competitive advantage.

4. **Involved with the execution in the supply chain**: The current design of IMLOG’s LLP concept for PRODA provides only services related to the elements in the supply chain. No service is provided that takes a whole supply chain into account instead only the link between one producer and a client is served.

5. **Own perspective in providing logistics services**: Although IMLOG is not neutral in business, a strict division is made between the task and responsibilities of IMLOG and the LLP transport partners. In some kind of way IMLOG acts in name of PRODA when it comes to LLP transport partner management. Because IMLOG is responsible for all services provided within the LLP concept, besides PRODA IMLOG benefits as well with good functioning LLP transport partners.

4.2.2 **Heading into the right direction**

1. **Total singular accountability**: IMLOG’s intention was to provide a full payment portal within the LLP concept it provides for PRODA. Due to legal circumstances IMLOG is not allowed to provide this payment service for inner transports in one specific European Union country. The LLP transport partner directly invoices the transports and if applicable extra costs directly to PRODA.

2. **Value creation within customer organisation**: Mainly driven by the customer IMLOG is focussed on costs reduction. The customer would like to see an increase in the service level of the logistics services provided at the same or more preferable lower costs. This makes it hard in practice to find opportunities to create value within the customer organisation. The focus on costs is also driven by the fact that IMLOG is heavily asset based, these assets have to be used as efficient as possible.

3. **Vertically and horizontally active across the supply chain**: The logistics services provided by IMLOG’s LLP concept mainly involves transportation of products from a loading PRODA loading location and a client’s delivery location. This can be recognised as vertically involvement of IMLOG within the supply chain. Due to the fact that LLP transport partners are involved in the IMLOG’s LLP concept for PRODA, IMLOG is horizontally active in the supply chain as well.

4. **Single point of contact**: For PRODA IMLOG is in theory the one and main contact point involving all outbound bulk liquid chemical shipments by land. Each shipment order is being forwarded and processed by IMLOG’s LLP department, which takes care of the delivery of the shipment. An exception exists for shipments where the buyer arranges the transport themselves, also known as customer pick-up. An exception on this characteristic can be found on an operational level. A good example is the activity involved with booking the loading slots. Due to practical efficiency reasons a LLP transport partner is in several situations allowed to book the loadings slots itself.

4.2.3 **Fundamental change needed**

**Leading role in logistics, supply and demand chain integration**: IMLOG’s is solely involved with the outbound (supply) logistics of PRODA. By providing administrative logistics services IMLOG is able to
take over logistics responsibilities of PRODA as well. No real supply chain process changes are developed and implemented to improve the current situation.

4.2.4 LLP key success factors scoring summary
Table 4.1 summarises the scoring of IMLOG’s LLP concept on the LLP key success factors identified from literature. “Low” implies that IMLOG fulfils this key success factor barely or not, “high” means that the key success factor is fully met.

<table>
<thead>
<tr>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leading role in logistics, supply and demand chain integration</td>
<td>Total singular accountability</td>
<td>Heavy asset based</td>
</tr>
<tr>
<td>Value creation within customer organisation</td>
<td>Influences time and space utility</td>
<td></td>
</tr>
<tr>
<td>Vertically and horizontally active across the supply chain</td>
<td>Priority on maximising usage of own assets</td>
<td></td>
</tr>
<tr>
<td>Single point of contact</td>
<td>Involved with the execution in the supply chain</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Own perspective in providing logistics services</td>
<td></td>
</tr>
</tbody>
</table>

4.3 Lessons learned from historical pitfalls?
As a LLP can be classified as a hybrid between a 3PL and a 4PL it is meaningful to discuss the identified structural issue (pitfalls) of 3PL relationships in relation with IMLOG’s LLP concept for PRODA. This will provide insight in which way IMLOG’s LLP concept for PRODA is able to steer clear of pitfalls. First a set of pitfalls will be discussed where IMLOG was not able improve the situation as a LLP compared to a situation fulfilling a 3PL role. Between brackets is mentioned the level IMLOG’s LLP concept encountered these pitfalls. The second set of characteristics shows that IMLOG is able to solve several structural issues of a 3PL relationship in their LLP concept.

4.3.1 Tricked and fooled again...

1. **No continuous improvement**: Besides coordination, planning and execution of transports, continuous improvement is LLP characteristic as well. In IMLOG’s LLP concept for PRODA little attention is given to continuous improvement. In the contract is an incentive agreed which should stimulate IMLOG’s LLP department to improve the service provided. Subjects of interest in continuous improvement are for example payload and (intermodal) routing optimisation. From this can be concluded that a focus in IMLOG’s LLP concept is on improvement of the current practices; “out of the box thinking” is hardly applied. Remarkable fact is that the operational staff of IMLOG’s LLP department is hardly involved with the improvement. These persons know between which boundaries improvement of the current processes is possible and could provide useful input in the improvement process. This shows that the potential of strategic logistics resources human and knowledge is not optimal used within the delivery of logistics services to PRODA.

   In the past several integral solution initiatives are proposed by IMLOG to improve the current practices. These integral solutions involve major changes in the working procedures in the supply chain. In the end PRODA abandoned the idea of implementing these integral solutions which discourage IMLOG in developing and proposing new innovative concept to improve the service provided with the LLP concept. This shows that PRODA has a major stake in continuous improvement as well.

   Continuous Improvement can be recognised not only related to the services provided to its customer, but within IMLOG as well. In the current situation no continuous improvement programme can be observed. If improvements occur it is mostly relates to the usage of resources but not operational process related.
2. **No extensive performance measurement programme:** In fact a performance measurement programme is applied within IMLOG’s LLP concept for PRODA. This programme is driven by the customer's need and therefore involves mostly operational performance measurement. Complaints from PRODA clients, loading locations and PRODA itself, the responsiveness on these complaints and the number of underweight shipments determining the overall service level of IMLOG’s LLP concept for PRODA. Other performance indicators do not influence the overall service level. A good performance measurement programme should take all operational, tactical and strategic aspects into account.

3. **Lack of pro-activity:** Solving issues and improving IMLOG’s LLP concept for PRODA requires a pro-active attitude. The current situation shows that pro-activity in IMLOG’s LLP concept is hard to find: for instance the lack of continuous improvement. As mentioned before, most of the cases IMLOG is not the only one to blame. A pro-active attitude of IMLOG is not appreciated by its customers in such a way that it will continue having this attitude. Therefore on one hand IMLOG has to be more pro-active and the customer should stimulate this by rewarding IMLOG for its effort.

4. **Visibility along the supply chain:** One of IMLOG’s most important strategic resources is its information system. Information is a fundamental element within logistics: without information no logistics service will be executed. In addition, providing (performance) information helps in satisfying PRODA’s information needs: it increases the visibility in the supply chain. In the current situation the need for information is PRODA driven, which results in a situation where PRODA only receives the information it asks for. It could be that the PRODA is not aware of the information available. By showing PRODA which information can be supplied could have a positive effect on the relationship between IMLOG and PRODA. Providing more information to PRODA leads to a better understanding of the logistics services provided within IMLOG’s LLP concept.

5. **Lack of IT support and commitment:** An information system cannot function without proper supported of Information Technology (IT). Although Electronic Data Interchange (EDI) is used for sending orders from PRODA to IMLOG’s LLP department, the full potential of IT is not used. For instance the shipments orders are send to the LLP transport partner by fax. Another example is the planning programme for the subsidiaries and LLP transport partners. These programmes are manually entered in a table and send, while all this information is stored in IMLOG’s information system as well. An option could be to use a query to generate the planning programme. In addition, lots of operational information, like true date of arrival et cetera, is manually entered in the system by the planner. Entering this information in the information system could be performed by a truck driver as well with support of an onboard truck computer, which saves the planner time. Here as well IMLOG’s LLP department is depending on the other parties involved. Parties like PRODA and the LLP transport partners must be willing to cooperate to experience the advantage of those IT related opportunities.

4.3.2 **Structural issues solved by IMLOG LLP concept for PRODA**

1. **Tailored system and structures:** The LLP concept is a perfect example of a tailored made solution for PRODA’s outbound liquid bulk chemicals logistics needs. Based on PRODA’s requirements IMLOG developed and implemented a system that coordinates and executes logistics services for PRODA. These logistics services consist out of mainly services which are already operated by IMLOG before it started operating the LLP concept: the physical logistics services. The LLP concept bundled these existing services in one logistics service package together with administrative logistics services. Most of these administrative logistics service are newly developed for the LLP concept. In this way IMLOG succeeded to customise the logistics services it provides according PRODA wishes. This can be identified as a high ability of problem solving and customer adaptation of IMLOG in the role of LLP. According Hertz and Alfredsson (2003), IMLOG in the role of LLP can be classified as a Service Developer.
2. **Pan European coverage**: Thru its network of subsidiaries and terminals across Europe and its own transport equipment IMLOG is able to provide its LLP logistics services on a European wide scale. In this way IMLOG can take care of the logistics needs of PRODA on a Pan-European scale: IMLOG acts a one-stop shop for PRODA.

3. **Flexibility**: Due to the fact that IMLOG is fulfilling a LLP role it has to care of PRODA’s logistics needs. PRODA has no possibility to involve other LSPs in case of (special) requests; therefore IMLOG is flexible to fulfil PRODA’s logistics needs.

4.3.3 **Summary of encountered pitfalls**

Table 4.2 summarises to what extend pitfalls, identified from literature, are encountered in IMLOG’s LLP concept for PRODA. “Low” means that IMLOG was able to neutralise (almost) totally, where “high” implies that this pitfalls can be recognised in daily business.

<table>
<thead>
<tr>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of tailored systems and</td>
<td>Poor visibility along the supply chain</td>
<td>No continuous improvement</td>
</tr>
<tr>
<td>structures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No pan European coverage</td>
<td>Lack of IT support and commitment</td>
<td>No performance measurement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>programme</td>
</tr>
<tr>
<td>Lack of flexibility</td>
<td></td>
<td>No pro-active attitude</td>
</tr>
</tbody>
</table>

4.4 **Concluding remarks on IMLOG’s LLPness**

A confrontation of the LLP concept from a theoretical perspective and from a practical perspective on IMLOG’s LLP concept for PRODA is made in this fourth chapter. Based on the fulfilment of the general critical success factor identified for a partnership, IMLOG’s LLP concept for PRODA is a partnership.

By applying a tool, the quality level of IMLOG’s partnership with PRODA is defined and shows that IMLOG scores sufficient on operation aspects of the partnership. More focus should be on the relational aspects of the partnership to increase the quality.

IMLOG’s LLP concept for PRODA fulfils fifty percent of the LLP concept critical success factors identified. Four of the critical success factors are not fully met, but with slight changes in the concept these factors could also be met in total. Only one critical success factors scores very low on IMLOG’s LLP concept for PRODA: IMLOG fulfils no full leading role in logistics, supply and demand chain integration. Treating this issue will have a direct big positive influence on IMLOG’s LLPness form a literature perspective.

With confronting IMLOG’s LLP concept for PRODA with the pitfalls identified in literature it can be concluded that most of the pitfalls are encountered. No continuous improvement, no extensive performance measurement programme and a lack of pro-activity are the most important pitfalls encountered. On the other hand with its LLP concept IMLOG was able to avoid completely the pitfalls involving a lack of flexibility and tailored systems and structures and the absence of pan European coverage.

It can be concluded that IMLOG LLP concept for PRODA involves a partnership based on its elements, but in fact does not behave as an optimal functioning partnership. Based on the fulfilment on the theoretical LLP key success factors, IMLOG cannot be classified as a full LLP in the concept it provides for PRODA from a theoretical perspective. Especially the low score on the “leading role in logistics, supply and demand chain integration and the medium score on “total singular accountability”, “value creation within the customer organisation”, “vertically and horizontally active across the supply chain” and “single point of contact” makes it impossible for IMLOG to be a full LLP at this moment.

The encountered pitfalls show as well that IMLOG was not able to neutralise current negative logistics business characteristics by operating its LLP concept for PRODA. This contributes heavily in the determination of IMLOG not acting as a full LLP for PRODA.
Nevertheless the analysis showed that IMLOG is on the right track in becoming a full LLP. The issues identified in the confrontation between practice and theory could serve as a start in a process where IMLOG becomes a full LLP.
5 Practical issues identified in IMLOG’s LLP concept

Now issues are identified based on comparison between IMLOG’s interpretations on the LLP concept in practice and literature, issues solely related to practice can be identified. Figure 5.1, which is a part of the issue identification framework, shows the three different types of issues that can be identified.

![Figure 5.1 - Issues derived from practice](image)

First paragraph in this chapter will go in more detail on issues related to soft aspects within the IMLOG’s LLP concept for PRODA: the relationship issues. Following issues involves the hard aspects of IMLOG’s LLP concept for PRODA: service fulfilment and operational issues are being distinguished. The second paragraph of this chapter will elaborate on the service fulfilment issues identified, where the last paragraph will go in more detail on the business process issues.

5.1 Relationship issues

Observations on IMLOG’s LLP concept for PRODA show that a few issues arise from the way the relationship is currently shaped. These issues cannot be quantified and influences the success of the concept from a quality perspective. Relationship issues are the result of customer expectations (PRODA) are not being met by the involved LSP(s) (IMLOG). Harland (1996) identified several types of causes of customer expectations not being met by the LSP. For this Harland developed a mismatch tool, see figure 5.2. This tool identifies four different mismatches, displayed by arrows. The most important mismatch identified by Harland, causing relationship issues, is the mismatch between the customer’s perception of requirements and the customer’s perception of performance.

![Figure 5.2 - Perception mismatch tool, adapted from Harland (1996)](image)

Rafele (2004) identified the underlying factors that influence expectations being met or not, see figure 5.3. The actual logistics services provided consist out of the physical logistics service supplied in combination with information actions related to these physical services provided. Combining these two elements with the desired service, results in a perceived service (level). The desired service level
receives its input from information obtained from the market. Obtaining this market information can be seen as benchmarking activities.

By using the Harland’s mismatch tool (see figure 5.2) it is logical to assume that the problem of expectations not being met lies in the benchmarking activity, the supplied services and information actions. When looking at IMLOG’s LLP concept for PRODA, possibilities to perform benchmarking activities are rather limited. First of all in the contract is agreed that PRODA is not allowed to benchmark in the first three years of operating the LLP concept (see paragraph 3.1) The second and maybe more interesting, cause can be found in one of the main characteristics of the LLP concept: the dependency on one LSP, in this case the LLP IMLOG. By relying on just one LSP it is less easy to obtain diverse market information than in the situation where multiple LSPs are involved. The limited possibility to perform benchmarking activities by the customer results as well in unawareness and causes misunderstanding at the customer side concerning the logistics services provided by IMLOG. For instance there is no fully awareness at the customer about IMLOG dependencies in the intermodal transport business. Another example is that the customer is not fully aware of IMLOG’s possibilities within chemical logistics services. The level of the physical logistics services supplied influences the level expectation fulfilment as well in a positive or negative way, depending on the balance between service and costs levels.

With the absence of many benchmark activities within IMLOG’s LLP concept for PRODA, information actions play an even bigger role in the perceived service. Nowadays these information actions are mostly customer driven: the customer only receives the information it asks for. When the customer asks for information or an explanation concerning a certain topic, the damage is already done and influences the perceived service in a negative way.

Concluding, unmet expectations within IMLOG’s LLP concept for LLP Europe are a mismatch between the customer’s perception of requirements and performance. A shortage on benchmark possibilities is main responsible for this, which is caused by a contractual agreement and the fundament characteristic of a LLP concept to do business with only one LSP. A lack of appropriate pro-active information actions influences the unmet expectations in a negative way.

5.2 Service fulfilment issues

With the determination of issues from practice, besides issues related to “soft” aspects of IMLOG’s LLP concept for PRODA “hard” aspects related issues can be distinguished as well. Service fulfilment issues results from external performance measurement (see paragraph 1.3). Within IMLOG’s LLP concept for PRODA a (n external) performance measurement programme applied to measure the

Figure 5.3 - Perceived service and desired service, adapted from Rafele (2004)
level of service fulfilment (see paragraph 3.3). This performance measurement programme does not take the costs of the logistics service provided into account. When the logistics services provided do not reach a certain level, issues will be the result.

Performance measurement date (source known by the author) on IMLOG’s LLP concept for PRODA provided input for the overall performance graph in graph 5.1. This performance graph shows that the overall performance lies on average between X and Y percent. Remarkable are the valley in the first quarter of point in time A and the valley point in time B (where the overall performance drops to Z percent).

![Graph 5.1 - Overall Performance level based on scoring KPIs (source known by the author)](image1)

Although the overall performance level provides quickly insight in the level of service fulfilment, it does not show the underlying causes of the behaviour of the overall performance level. In this case the overall performance level cannot explain the valley in the overall performance at point in time B 2010. Therefore the score on the overall performance level KPIs have to be examined. Graph 5.2 shows the development of the KPIs used for scoring in relation with the total number of shipment delivered. This graph shows that the number of underweight order declines from the start very irregularly, with a slow increase from point in time C onwards. All other scoring KPIs know unstable behaviour. The valley in the overall performance at point in time B can be explained by a combination of a high Service Request Improvement level in combination with a high number of underweight orders.

![Graph 5.2 - Scoring KPI value development (source known by the author)](image2)
Besides scoring KPIs, the currently used performance measurement programme includes non scoring KPI’s as well, which are only used for a monitoring purpose. Graph 5.3 shows scoring on the non scoring KPIs, in relation with the total number of shipments delivered, where IMLOG is fully responsible for. It can be recognised that the level of near misses and late pickups remain more a less the same. Remarkable is the irregular development of the late deliveries level with a peak in June 2010. It could be assumed that the high Service Improvement Request level is the result of the high level of late deliveries.

![Graph 5.3 - Performance on non scoring KPIs (source known by the author)](image)

Bases on the graphs in graphs 5.1 to 5.3 the unsteady behaviour of two KPIs attracts the attention: the number of underweight shipments and the number of late deliveries. Shipments are classified as underweighted when the real shipped quantity is more than five percent less than was requested. This is caused by not having suitable containers available that are able to load the quantity requested at a certain moment. Late deliveries can have all kind of causes: from train delays, to traffic jams and planning mistakes to equipment failure. The unsteady behaviour of these two KPI’s can be classified as notable service fulfilment issues.

Rohner (2010) emphasises that service levels of the logistics service provided increased at lower costs for PRODA compared to the situation without a LLP concept in place. This shows that the decision of PRODA to involve a LLP for its European road and intermodal bulk chemical logistics was good one. With the deployment of a measurement programme insight in the current performance of the LLP concept IMLOG for PRODA is provided. One of the weakest points in the current measurement programme is the overall performance rate. The factor weights used for calculating this overall performance, based on the scoring KPIs, is highly subjective, which is not desirable when an objective performance measurement is needed. Another weak point in the currently used performance measurement programme is that there are no strict rules agreed when the contract will be terminated based on underperformance. It is highly subjective and depending on PRODA, because she decides when to terminate the contract when IMLOG underperforms. The fact that performance targets are agreed upon at the start of each year does not make it easier as well to determine the LLP concept’s success from a service fulfilment issue perspective.

**5.3 Business process issues**

Next to looking at the quantitative performance of the logistics services delivered in IMLOG’s LLP concept, it is also important to take the internal performance into account. This internal performance is related to the way the logistics services are operated within the IMLOG’s LLP concept. In the current situation there is not a structured framework applied to measure the internal performance, apart from the performance measurement programme that is driven by the customer (see previous paragraph). Therefore it is hard to identify internal business process issues based on quantitative performance measurement. A solution for discovering business process issues is found in experiencing daily practice at IMLOG’s LLP department. By functioning as a full member of IMLOG’s
LLP department understanding is obtained on the positive sides of the concept, but also on the improvement opportunities which results out of issue. Due to this approach the business process issues are very operational related, but provides insight in the difficulties experienced internally. The most noticeable business process issues identified are:

1. **High number of order amendments**: In the current way of working a lot of time is spent on processing amended shipment orders: with each incident the related logistics service partners has to be informed. After an order is initially placed by PRODA, several different actors can ask for an amendment. These amendments involve mostly a change of the loading and/or delivering date, but a change in another shipment order profile characteristics is possible as well (see appendix C for the shipment order profile). The requests for amendments are originated from all the actors that are involved within the LLP concept: PRODA, PRODA’s clients, IMLOG, logistics transport partners. Reasons for these amendments can differ a lot: no product availability at the loading location, no storage capacity at the client’s site, no equipment availability for transport or due to planning efficiency reasons a request for amendment is placed.

2. **Slow reaction time shipment order**: The reaction time of IMLOG’s LLP department on a new or amended order is not always optimal. Especially in the case of so called rush orders this results in unnecessary problems: the time for finding a solution to a specific rush order is shortened by this issue. This issue is caused by the fact that the IMLOG’s LLP department’s administrator does not receive directly the orders from the printer. Another person within IMLOG is responsible to collect all new and amended orders from all IMLOG’s clients and distribute them among the disposition departments involved.

3. **Information deviation**: Due to the fact that is not possible to amend a shipment order in PRODA’s information system when it is loaded, dissimilarities between the information system of IMLOG and PRODA occur. Therefore it is not possible for PRODA to rely fully on their information system; the correct information is therefore inside IMLOG’s information system.

4. **Strategic slot booking** behaviour: Booking of the loading slots is in most cases a task of IMLOG’s LLP department when it involves logistics transport partners. On LLP transport partner forms an exception: it is allowed to book it own loading slots. From strategic behavioural reasons it reserves a set of loading slots at once without knowing which shipments to load. This causes problems for other planners within the LLP concept to book loading slots in line with their planning.

5. **Subsidiary planning**: Within IMLOG’s LLP concept for PRODA IMLOG’s subsidiary in location A plays a major role. This terminal is close to the two PRODA production plants in location A and takes care of a significant part of the shipments loaded at these two plants. The IMLOG’s LLP department is not the only internal client of the IMLOG terminal in location A. In case of operational problems one internal customer of IMLOG terminal has a higher priority than another customer. This leads to a lot of stress and misunderstanding at IMLOG’s LLP department and the subsidiary in location A.

6. **Third party equipment maintenance**: Dedicated equipment from LLP transport partners is used within IMLOG’s LLP concept for PRODA. This dedicated equipment requires maintenance and different kind of checks. IMLOG’s LLP department is responsible for making the arrangements that the dedicated equipment will be sent to the LLP transport partners’ maintenance shop. The collaboration between the LLP department and this specific LLP transport partner on this topic is not running smoothly, which results in mainly equipment availability problems.

7. **Container assignment**: Due to the fact that the other sub-departments within IMLOG’s disposition department control a set of all-use containers themselves, is it relatively easy to assign containers to shipment orders related to this specific department. Although the LLP department controls dedicated containers for specific product, other products have to be transported by use of all-use containers (which are mostly controlled by other departments).
The transports that involve all-use containers accounts between the ten and fifteen shipment loadings per day, so each day the LLP department has to search for available all-use containers at other department. Due to the fact that other departments tend to use first the available all-use containers for their own shipments and, leftovers are for other departments. Combine this fact with the shortage of all-use containers in general and a situation result where a lot of time (and money) is spent on searching for available all-use containers.

8. **Tasks & responsibilities:** Within IMLOG’s LLP department it is not always clear which person is responsible for certain tasks, excluding the administrative and planner functions. This makes it hard to check whether someone takes care of his or her responsibilities or not.

9. **PGI process:** After product is loaded at one of PRODA’s loading location, the shipment order record has to be updated (PGI-ed) by PRODA. This PGI related to information about the quantity of the product loaded et cetera which is supplied by the loading location. The next step is creating a Certificate of Analysis (CoA) related to the product loaded and it should be send to the delivery location by PRODA. This CoA has to be at the delivery location at the moment the shipment arrives; else wise the client does not accept the shipment. On regularly base the CoA is not available at the delivery location which result is lots delays before the truck is being unloaded. This counts especially for shipments where little time is in between moment of loading and delivering.

10. **Pre-load activities:** Several times a year it occurs that a storage tank at the third party location has to be emptied. First reason could be that the contract ends and that before the end of the month the tanks should be empty. It is a waste to dispose the product, therefore it has to be loaded into tank containers or tank trailers and be stored somewhere. Another reason when this activity occurs is when a ship with new product arrives at the third party storage location and the storage tank is still full. By moving product from the storage tank into tank containers and tank trailer, the ship can fully unload. This activity is now handled on an incidental base and therefore causing a lot of work making the arrangements. The case is as well that these arrangements has to be made within a relatively short time period, which results in stress at well.

5.4 **Concluding remarks on practical issues indentified in IMLOG’s LLP concept**

IMLOG’s LLP concept issues encountered in practice was the main topic of interest in the last chapter. Three types of issues are being distinguished: the “soft” relationship issues and the “hard” service fulfilment issues and the business process issues. The relationship issues encountered are the result of unmet expectations by PRODA. Due to the absence of extensive benchmark activities in the concept and pro-active information supply from IMLOG’s side are identified as causing factors. Service fulfilment issues are identified by means of the currently applied performance measurement structure. Performance data from the beginning of IMLOG’s LLP concept for PRODA is analysed. It can be concluded that the service levels are increased against lower cost after the deployment of IMLOG’s LLP concept for PRODA. Nevertheless the performance data show that the number of underweight shipment and the number of late deliveries know very unstable behaviour, which therefore can be classified as the two main service fulfilment issues.

Numerous business process issues are identified which are involved with the daily key operational processes within IMLOG’s LLP concept for PRODA. Most of the issues identified are related to the internal processes of IMLOG LLP department, where a few are related to the interface with the LLP transport partners and PRODA.

The identified partnership, service fulfilment and business process issues will serve together with the identified concept issues as input for the determination of improvement opportunities in the next part of this report.

The issues identified in this chapter should be viewed as improvement opportunities through which IMLOG can improve its LLP concept for PRODA from a relationship, service fulfilment and business process perspective.
PART II

Determination of improvement opportunities & selection
Based on the different types of issues identified in the previous two chapters, in this chapter improvement opportunities will be searched for. Taking advantage of these improvement opportunities will lead to solving the related issues. As mentioned before, restrictions within the project do not allow elaborating on each of the improvement opportunities that will be identified in this part of the report. Therefore, this part concludes in the selection of one improvement opportunity that will be further elaborated in the third (design) part of the report.

Identification of improvement opportunities from the issues identified will be performed by use of improvement domains. These improvement domains consist of issues clustered together. From each of the improvement domains, improvement opportunities will be derived. Those improvement opportunities will relate to one or multiple issues. Figure F shows the steps that will be taken in this part towards the selection of one improvement opportunity.

![Figure F - Improvement opportunity selection methodology](image-url)
6. From issues towards a design subject

6.1 Improvement domains

According the methodology shortly described in the introduction of the second part of this report, the domains of improvement must be determined before improvement opportunities can be identified. Those improvement domains must be derived from clustered issues that are identified in the first part of this report.

First type of issues is related to the LLP concept design IMLOG operates for PRODA. These issues are identified based on a confrontation between the theory written in literature and IMLOG’s practical interpretation of the LLP concept. The second type of issues involves the relationship between IMLOG and the LLP concept taker, which is in this case PRODA. These issues influence the perceived success of IMLOG’s LLP concept. Some of the relational issues are mentioned as well in the literature. The third type of issues is related to service fulfilment and has a direct link with the physical and administrative logistics services provided within the LLP concept IMLOG provides for PRODA. This type of issue is mainly focussed on the service level agreement between IMLOG and PRODA. The fourth and the last issue type relates to the internal business process of IMLOG. The way these internal business processes are organised and operated, have a direct influence on the service level related to the physical and administrative logistics services IMLOG provides.

The issues identified from practise are already classified according three different types: relationship, service fulfilment and business processes. This is in contrast with the concept issue resulting from the confrontation between literature and practice. Those concept issues only distinguish unfulfilled characteristics and encountered pitfalls. The unfulfilled characteristics and encountered pitfalls can be related as well to relationship, service fulfilment or business process. These three classes will form the improvement domains from which improvement opportunities will be derived. Table 6.1 shows for each identified issue its related improvement domain, where is mentioned which issue is originally a concept issue. Only concept issues scoring low and medium on LLP characteristics and concept issues scoring medium and high on encountered pitfalls are taken into account. Especially these concept issues contain improvement potential.

<table>
<thead>
<tr>
<th>Relationship domain</th>
<th>Service fulfilment domain</th>
<th>Business process domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unmet expectations</td>
<td>Underweight shipments</td>
<td>High number of order amendments</td>
</tr>
<tr>
<td>Lack of pro-active information supply</td>
<td>Quality of performance measurement</td>
<td>Slow reaction time shipment order</td>
</tr>
<tr>
<td>Leading role in logistics, supply and demand chain integration (concept issue)</td>
<td>Late deliveries</td>
<td>Information deviation</td>
</tr>
<tr>
<td>Value creation within customer organisation (concept issue)</td>
<td></td>
<td>Strategic slot booking</td>
</tr>
<tr>
<td>Vertically and horizontally active in the supply chain (concept issue)</td>
<td></td>
<td>Subsidiary planning</td>
</tr>
<tr>
<td>No continues improvement</td>
<td></td>
<td>Third party equipment maintenance</td>
</tr>
<tr>
<td>No extensive performance measurement (concept issue)</td>
<td></td>
<td>Container assignment</td>
</tr>
<tr>
<td>Lack of pro-activity (concept issue)</td>
<td></td>
<td>Tasks &amp; responsibilities</td>
</tr>
<tr>
<td>Visibility along the supply chain (concept issue)</td>
<td>No total singular accountability (concept issue)</td>
<td></td>
</tr>
<tr>
<td>Lack of IT support and commitment (concept issue)</td>
<td>No single point of contact (concept issue)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PGI process</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pre-load activities</td>
<td></td>
</tr>
</tbody>
</table>
6.2 Improvement opportunities uncovered

The previous paragraph showed that all identified issues can be related to three main improvement domains: relationship, service fulfilment and business process. For each of the three domains improvement opportunities can be identified. These improvement opportunities are derived from one or multiple issues, with a focus on finding a common denominator within the improvement domain. This process led to the four main improvement opportunities, which are displayed in figure 6.1.

![Diagram showing improvement opportunities derived from three improvement domains]

The following four main improvement opportunities are derived from the three improvement domains and should solve the related issues:

1. **Business approach change**: lots of issues in the partnership domain result from the fact that IMLOG does not fulfill the characteristics of a LLP from a literature perspective. To be able to shape IMLOG’s LLP concept more towards the literature based profile of a LLP, certain changes are essential. These changes will influence IMLOG’s current way of performing business: its business approach. Its business approach is a derivative of their business strategy, which will be influenced as well by these changes. Support within the company is the key to successfully implementation of these changes, where change management plays a major role.

2. **Customer Relationship Management (CRM)**: other partner issues result from unmet expectations of PRODA. Apparently problems exist in managing PRODA’s expectations in IMLOG’s LLP concept and the relationship as well. Therefore an integral approach is needed at IMLOG’s that focuses on managing the relationship with PRODA including their expectations.

3. **Performance measurement structure**: both identified concept issues and service fulfilment issues show that performance measurement in IMLOG’s LLP concept is not optimal. By developing and implementing an extensive performance measurement structure, the related issues can be solved.

4. **Business process change**: the solution to certain service fulfilment issues can be found in the investigation of related business processes and taking the necessary actions. Actions could consist out of small changes in current procedures toward full process redesign. This approach can also be applied in solving business process issues.

The last three mentioned improvement opportunities will be elaborated further on in this paragraph. The improvement opportunity concerning business approach change will not be further discussed due to the fact that this involves changes in IMLOG strategy’s key characteristics. It is not a topic of interest in this project to elaborate how IMLOG should change its business strategy.

6.2.1 Customer Relationship Management

The LLP concept is customer driven, because of the supporting character of the logistics services provided within the concept. Therefore the success factors and the pitfalls are heavily influenced by the customer of the LLP. Improving the success of IMLOG’s LLP concept by adjusting the concept will
influence the relationship between the LLP as well. The relational issues influence the quality of the relationship in a negative way. By finding an integral way to manage the relationship between the LLP and the customer, the relational issues identified could be solved and concept issues can be overcome as well.

In literature a lot is written about how to manage the relationship a company has with its customer(s), where Customer Relationship Management (CRM) provides an integral approach. The main focus within CRM is on customer retention and customer development and requires a balanced and integrated approach of technology, process and people (Chen & Popovich, 2003; Kim et al, 2003). According Kim et al (2003) the fundamental nature of CRM lies in changing organisation’s strategy from product-centric to customer centric. This requires changes in technology, process and people within the company that is willing to adopt a CRM strategy.

Customer satisfaction drives CRM

CRM knows four fundamental pillars: customer knowledge, customer interaction, customer value and customer satisfaction (Kim et al, 2003). Customer knowledge is about obtaining insight in the customer needs and wishes, combining and analysing, integrating this information (Campbell, 2003).

![Figure 6.2 - Four pillars within CRM (Kim et al, 2003)](image)

The customer knowledge information is used for marketing and tailoring of the services and or products to the client’s needs, which is known as customer interaction. Also the drive for operational excellence characterises customer interaction. Thru customer interaction customer value is increased through higher commitment and an increase in loyalty, which leads to higher customer retention. Finally the level customer satisfaction (which influences the level of customer retention) depends on to which extend the customer’s expectations are met by the product of service. According Kim et al (2003) customer satisfaction within CRM can be described by use of five dimensions: assurance, reliability, empathy, responsiveness and tangibles. The effectiveness of adopting a CRM approach can therefore be measured by the satisfaction level of the customer.

Information is crucial when managing a customer relationship (Jayachandran et al, 2005), which can be concluded from the four pillars of CRM as well. Three types of information can be distinguished in CRM: information of the customer, information for the customer and information by the customer (Park & Kim, 2003). Information of the customer is the type of information that is used to gather customer knowledge; customer’s personal and transactional information. Information for the customer involves desired information of the customer that is provided. This type of information is mainly found within customer interaction, which is for information by the customer as well. This type of information is supplied by the customer and relates to for instance complaints.
Managing information in CRM processes, especially when looking at customer knowledge and interaction, use of IT is essential. Jayachandram et al (2005) concluded in their paper that extensive use of IT in CRM has a positive effect on the customer satisfaction level.

**A CRM strategy framework**

When IMLOG decides to adopt a CRM strategy pro-actively, a process based CRM strategy framework suggested by Payne and Frow (2005) can be very helpful. Their framework consists out of four cross-functional CRM processes: A strategy development process, a value creation process, a multi channel integration process, an information management process and a performance assessment process.

![Figure 6.3 - Simplified CRM strategy framework, adopted from Payne & Frow (2005)](image)

The strategy development process is the starting point in CRM with a distinction between business strategy and customer strategy. Business strategy involves the vision of the company, the related goals and the steps to take to reach the goals. Customer strategy is about analysing the needs and behaviour of customers. Based on this first step customer segmentation can be applied. Here a link can be recognised with two out of four CRM pillars: customer knowledge and customer interaction.

The value creation process involves the identification of the value the company can deliver to its customer, the value the customer can receive from the customer and the coordination of these two forms of value exchange. Here there is an obvious link with the customer value CRM pillar.

The multi channel integration process results from the strategy development and value creation process. Based on the latter two types of processes, value-adding activities for the customer are developed, implemented and operated. Essential in the multi channel process is the way those channels or used to create in a most optimal way value for the customer. The multi channel integration process can be seen as a part of the customer interaction pillar.

As already mentioned above information is one of the key fundaments in successful CRM, which have to be managed in good way. Therefore the framework proposes an information management process that supports the other processes in the framework. Elements within this process are IT-systems, analytic tools, back and front office applications.

For measuring the success of the CRM strategy, the customer satisfaction, the framework proposes a performance assessment process. First of all, this process monitors the performance of the services or product delivered by the company. Within this monitoring process uses standards, qualitative and quantitative performance measures. Secondly the performance assessment process checks as well to which extend company and customer value is created. Based on the outcome of the performance assessment process measures can be developed and implemented to improve the performance. A more elaborated version of the CRM strategy framework proposed by Payne and Frow (2005) can be found in appendix H.

**6.2.2 Performance measurement structure**

In literature a lot is written about performance measurement, not only in general but also specific for LSPs. Hoek (1998) identifies in his paper the need of a new kind of performance measurement. He addresses the current way of measuring performance and the desired one, by providing a preliminary framework for measuring performance. Krauth et al (2005) provide a logistics service performance measurement framework that distinguishes between an internal and an external...
performance perspective on a short and long horizon. For each combination between perspective and horizon they address numerous performance indicators which can be used. Rafele (2004) describes in his paper a hierarchical performance measurement reference model, which helps selecting the appropriate performance indicators. Choy et al (2008) propose a detailed knowledge-based logistics performance measurement system (K-LPMS).

Developing and implementing such a performance measurement programme will contribute to a CRM approach and the identification service fulfilment issues in a positive way as well. Gathering, storing and analysing performance information requires a well developed information system. This information system will support IMLOG in supplying the customer with information pro-actively: it will be easier to retrieve certain performance information from the business. Development and implementation of an extensive information system will contribute to performance of business processes as well: it enables, together with IT, automation within these business processes. An example is that a good functioning information system will solve the issue of information deviation between IMLOG’s and PRODA.

### 6.2.3 Business Process Change

Based on the service fulfilment and business process issues, business process change improvement opportunities can be identified. These business process change opportunities propose a change in the way IMLOG’s LLP concept for PRODA is currently operated to solve each the previously identified issue. Grover and Malhotra (1997) identified five different types of change programmes to solve internal business process issues: rightsizing, restructuring, automation, Total Quality Management (TQM) and reengineering. These different types of change programmes can be compared thru several factors, where table 6.3 compares the change programmes according these factors. Depending on the characteristics of the business process change opportunity a certain change programme can be adopted for improvement.

<table>
<thead>
<tr>
<th>Assumptions questioned</th>
<th>Rightsizing</th>
<th>Restructuring</th>
<th>Automation</th>
<th>TQM</th>
<th>Reengineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staffing</td>
<td>Reporting relationships</td>
<td>Technology applications</td>
<td>Customer Needs</td>
<td>Fundamental</td>
<td></td>
</tr>
<tr>
<td>Focus of change</td>
<td>Staffing, Job responsibilities</td>
<td>Organisation</td>
<td>Systems</td>
<td>Bottom-up improvements in many places</td>
<td>Radical changes of broad core entities</td>
</tr>
<tr>
<td>Orientation</td>
<td>Functional</td>
<td>Functional</td>
<td>Procedures</td>
<td>Processes</td>
<td>Processes</td>
</tr>
<tr>
<td>Role of IT</td>
<td>Often blamed</td>
<td>Occasionally emphasised</td>
<td>To speed op existing systems</td>
<td>Incidental</td>
<td>Key</td>
</tr>
<tr>
<td>Improvement goals</td>
<td>Usually incremental</td>
<td>Usually incremental</td>
<td>Incremental</td>
<td>Incremental</td>
<td>Dramatic and significant</td>
</tr>
<tr>
<td>Frequency</td>
<td>Usually one time</td>
<td>Usually one time</td>
<td>Periodic</td>
<td>Continuous</td>
<td>Usually one time</td>
</tr>
</tbody>
</table>

**Service fulfilment improvement opportunities**

Table 6.4 shows for the three major service fulfilment issues identified the proposed change programme. The table provides insight as well in the business function to which the issue is related and in which area a solution can be found to solve the issue. Underweight shipments are the results of not having available suitable containers, resulting in container without the right capacity being assigned to the shipment order. Therefore a solution can be found in the way containers are assigned to shipment orders. Reengineering could serve as a perfect approach to solve the issues of underweight shipments. First of all the container assignment process is an essential activity within IMLOG’s logistics coordination. Changing this process will impact the entire organisation and where IT could have a key role in solving the issues.
The current way of performance measurement applied in IMLOG’s LLP concept does not provide insight in the performance of each element and aspect in the concept. Performance measurement itself is not a vital activity in logistics coordination and execution, but has a more supporting character. Performance measurement is needed to be able to improve performance. By reengineering the performance measurement structure the quality of the performance measurement could be increased. Previously is discussed how performance measurement should be structured and could be valuable for other elements in the LLP concept as well.

Late deliveries are identified as a service fulfilment issue as well. Different causes can be named for a late delivery, where IMLOG is not always the one causing the delay. Due to the intermodal characteristics of the logistics services IMLOG provides, IMLOG is depending on lot of intermodal transport partners. When some kind of activity at an intermodal transport partner experiences a delay, will result in a further delay up until the shipment is being delivered. This shows that this issues is not only internally oriented, but also externally towards the intermodal transport partners. Therefore it is not that easy to propose one of the change programmes mentioned in table 6.4 which are mainly internal oriented.

**Business process improvement opportunities**

As with service fulfilment issues, for each of the business process issues identified the related business function and a solution area can be ascribed, in addition to a proposed change programme. Table 6.5 shows this for each of the business process issues. Most of the business process issues are related to essential processes within the operations of IMLOG’s LLP concept for PRODA. A solution to these issues can be found in changing the related processes.

---

**Table 6.3 - Business process change improvement opportunities from the service fulfilment domain**

<table>
<thead>
<tr>
<th>Issue</th>
<th>Business function</th>
<th>Improvement opportunity found in</th>
<th>Proposed change programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight shipments</td>
<td>Operations</td>
<td>Container assignment process</td>
<td>Reengineering</td>
</tr>
<tr>
<td>Quality of performance</td>
<td>Support</td>
<td>Performance measurement structure</td>
<td>Reengineering</td>
</tr>
<tr>
<td>measurement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late deliveries</td>
<td>Operations</td>
<td>Dependencies</td>
<td></td>
</tr>
</tbody>
</table>

**Table 6.4 - Business process change improvement opportunities derived from business process domain**

<table>
<thead>
<tr>
<th>Issue</th>
<th>Business function</th>
<th>Improvement opportunity found in</th>
<th>Proposed change programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>High number of order amendments</td>
<td>Operations</td>
<td>Order processing process</td>
<td>TQM</td>
</tr>
<tr>
<td>Slow reaction time shipment</td>
<td>Operations</td>
<td>Order processing process</td>
<td>Automation</td>
</tr>
<tr>
<td>order</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information deviation</td>
<td>Support</td>
<td>Information system</td>
<td>Reengineering</td>
</tr>
<tr>
<td>Strategic slot booking</td>
<td>Operations</td>
<td>LLP transport partner management</td>
<td>Automation</td>
</tr>
<tr>
<td>Subsidiary planning</td>
<td>Operations</td>
<td>Governance structure</td>
<td>Rightsizing</td>
</tr>
<tr>
<td>Third party equipment</td>
<td>Operations</td>
<td>Equipment maintenance coordination process</td>
<td>Restructuring</td>
</tr>
<tr>
<td>maintenance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Container assignment</td>
<td>Operations</td>
<td>Container assignment process</td>
<td>Reengineering</td>
</tr>
<tr>
<td>Tasks &amp; responsibilities</td>
<td>Operations</td>
<td>Governance structure</td>
<td>Rightsizing</td>
</tr>
<tr>
<td>No total singular accountability</td>
<td>Operations</td>
<td>Governance structure</td>
<td>Rightsizing</td>
</tr>
<tr>
<td>No single point of contact</td>
<td>Operations</td>
<td>Governance structure</td>
<td>Rightsizing</td>
</tr>
<tr>
<td>PGI process</td>
<td>Operations</td>
<td>Further integration</td>
<td></td>
</tr>
<tr>
<td>Pre-load activities</td>
<td>Operations</td>
<td>Further integration</td>
<td></td>
</tr>
</tbody>
</table>
In case of the slow reaction time on a shipment order and the strategic slot booking automation can be a perfect solution. TQM can be applied in the issue of the high number of order amendment. This change programme identifies the underlying causes of the order amendments and guides the development and implementation of appropriate measures. Restructuring could be the solution to the issue concerning third party equipment maintenance. Resetting the rules and responsibilities among the parties involved could be the first step in solving this issue. The subsidiary planning issue, the tasks and responsibility issue, the no total singular accountability and no single point of contact issue can be solved by applying rightsizing. By adopting this change programme a clear governance structure can be formed, with no room for misunderstanding on each other’s task and responsibilities within the LLP concept. The business process issue related to the assignment container fulfils a business function in operations with a solution to be found in the container assignment process. These issues share similarities with the service fulfilment issue on underweight shipment, see above. Therefore reengineering the container assignment process can be applied to solve this issue as well.

The deviation in information asks for a reengineering approach as well. Obviously there are problems with the information systems of IMLOG and PRODA that causes these deviations. Within reengineering the information system a major role exists for IT to optimise its functionality. Although information and its related system are vital for operational processes within IMLOG’s LLP concept for PRODA; it fulfils a supporting business function.

The PGI process and the pre-load activities issues occur during operations, but it is hard to assign a certain change programme to solve those issues. That is because the solution to these issues cannot be found in processes currently controlled by IMLOG. The PGI process is fully under responsibility of PRODA so IMLOG can not influence this process directly. The same counts for pre-loading activities which are requested by PRODA on an ad hoc base. A solution to these two issues can be found in further integration between IMLOG and PRODA on an operational level. These solutions could involve specially developed, standardised services to make, for instance, the execution of pre-load activities more structured.

6.3 Selecting an opportunity for further elaboration

6.3.1 Narrowing the set of improvement opportunities

Due to restrictions within the project, not all improvement opportunities can be further developed towards implementation. Therefore a certain improvement opportunity has to be chosen to elaborate upon. Within this decision IMLOG has logically a major stake, because it initiated the project.

IMLOG is first informed about the identified issues, improvement domains and the improvement opportunities. Additionally criteria were supplied to IMLOG which could help IMLOG in the decision making process to elaborate on one or multiple improvement opportunities. The main criteria supplied are improvement potential, investment needed, organisational resistance, development period length, implementation period length and complexity of design.

Taking the identified issues, improvement domains, improvement opportunities and the criteria into account, IMLOG proposed to elaborate on the performance measurement structure or the container assignment process.

6.3.2 Reengineering the container assignment process: the right direction to go

To develop both the performance measurement structure and the container assignment process in detail is not perceived to be viable in this project. Therefore one of the two improvement opportunities must be selected for further elaboration: comparing the two improvement opportunities based on criteria. The following criteria are applied in the selection process:

1. Facilitate growth: IMLOG’s future strategy stands for further business growth (Rohner, 2010). Therefore the improvement opportunity chosen must contribute in facilitating this business growth.
2. **Improve internal performance**: to be able to grow, the organisation must be able to support this. According the author, improving internal performance is one of the first steps to take to facilitate this growth. Therefore the improvement opportunity to be chosen must be contribute to the improvement of IMLOG’s internal performance.

3. **Creating a win-win situation**: due to the fact that lots of improvement opportunities are identified, the chosen one should influence the customer in a positive way as well. When benefits are not solely gained by IMLOG, the relationship between IMLOG and the customer could be affected positively as well.

4. **Challenging elaboration process**: further elaboration on the chosen improvement opportunity should be challenging. This implies that the topic of interest must be unique and should not involve tailoring an off-the-shelf solution.

Looking at the chosen improvement opportunities by IMLOG, both facilitate growth in their own way. The performance structure improvement opportunity facilitates growth in an indirect way: it enables to improve the performance of IMLOG’s internal processes. Without an appropriate performance measurement structure it is hard to identify the processes that must be improved to facilitate growth. By reengineering the container assignment process provides in a more direct way possibilities to facilitate growth of business. Reengineering this process enables IMLOG to optimise the process and to cope with increasing number of shipments. These increasing numbers of shipment order, for which containers are needed, are considered to be a result business growth within IMLOG. This shows as well that reengineering the container assignment process will contribute to the improvement of IMLOG’s internal performance.

Reengineering the container assignment process will lead directly to a win-win situation for both IMLOG and the customer. Through this reengineering process IMLOG’s internal performance will be improved, where the customer benefits directly thru service fulfilment issues are being solved. For example the issue on underweight shipments can be solved by applying a better, reengineered container assignment process. The improvement opportunity concerning the performance measurement structure does not create a real win-win situation. IMLOG will be able to gain more insight in their performance, which it can use for identification of improvement opportunities. The customer can only use the performance measurement structure to monitor and steer IMLOG to improve performance indirectly.

The challenge of performance measurement structure improvement opportunity will not be in the development, but in tailoring a certain performance measurement framework to IMLOG’s business. This is in contrast with reengineering the container assignment process, where a tailor made solution has to be made considering each characteristic of IMLOG’s disposition process. Reengineering the container process will result in a new design on the container assignment process, although basic principles will be applied in the assignment processes.

Comparing both selected improvement opportunities based on criteria shows that reengineering of IMLOG’s container assignment process scores best on the criteria applied. Therefore reengineering the container assignment process will be the main topic of interest in the following third part of this report where a functional design will be developed.

Reengineering of the container assignment process is perfectly suitable for taking advantage of this improvement opportunity. First of all the container assignment process is a fundamental part within IMLOG’s business which is being questioned by this improvement opportunity. For example without container assignment no transport is physically being performed. Because the container assignment process is a fundamental part, changing it will influence many processes throughout the entire company. With the current knowledge it can be assumed that IT can fulfil a key role in the reengineering of the container assignment process to reach a certain level of optimisation. Reengineering the container assignment process can be recognised as a onetime event that changes processes to reach related improvement goals at dramatically.
Although the decision is made for reengineering the container assignment process, the other improvement opportunities identified are high promising as well. Therefore IMLOG should elaborate on these opportunities as well to improve its LLP concept in total.
PART III

Design of an integral container management system
The previous part concluded to focus on reengineering the container assignment process instead of another identified improvement opportunity. This third part of the report will elaborate on the reengineering of the container assignment process, with as main deliverable a functional design. Further steps towards implementation will be taken, but actual implementation will not be conducted due to constraints within the project.

Based on reengineering literature of Grover and Malhotra (1997) and Talwar (1993) a reengineering approach is derived which cover the steps towards the functional design to be delivered. The following steps are distinguished:

1. **Scoping the design task**: first step in the reengineering approach involves definition of the design task’s scope. Without setting clear boundaries it will be hard to develop a qualitatively good functional design. This step concludes in a more specific design objective and design problem questions specifically for this design task.

2. **Formulating requirements**: requirements are formed which enables to make a design that solves the issues identified during the business analysis. The formulated requirements will be used to determine the quality of the design by verifying the fulfilment of the requirements by the developed functional design. Requirements are drawn up within the determined scope of the design task of the first step in the reengineering approach.

3. **Creation**: Next step in the reengineering approach involves the development of the functional design, where the quality will be determined by the requirement fulfilment level.

4. **Implementation topics**: based on the design resources needed for realising the design, the involved costs and process change management involved with the implementation of the design will be discussed. Additionally other topics towards implementation are discussed as well.

Each of the above mentioned steps will be handled in a separate chapter following this introduction.
7 Scoping the design task
The decision to elaborate on the reengineering of IMLOG’s container assigned process shows that the current approach in container assignment is underperforming. Symptoms of IMLOG’s container assignment process underperformance can be found in current practices. These symptoms are the number of underweight shipment (service fulfilment issue) and the high amount of time spent on the search for suitable containers (business process issue).

In paragraph 5.3 is mentioned that containers are controlled and assigned to a shipment order on a decentralised level. In case a department has a shortage on containers, containers must be sourced from other department. This result in lots of time spent on acquiring suitable containers due to personal strategic behaviour. The most obvious approach in improving the situation and solving the issues is by centralising IMLOG’s current container assignment process. In this way containers are assigned to shipment orders without being exposed to personal strategic behaviour, which is the case in the current situation. This should result in shorter period in which a container is being assigned from the moment IMLOG receives the shipment order. Members of IMLOG’s disposition department could be deployed more effectively as well; for instance by focussing on planning tasks.

7.1 An integral container management approach

7.1.1 Container management functions to be included in the approach
With the idea born of centralising the container assignment process, it would not be unwise to investigate other container related processes that are decentralised organised as well. Especially the processes of which the performance can be improved by centralisation should be considered. By taking these processes into account in the reengineering process an integral container management structure can be obtained.

Investigating current practices involving containers shows that, besides container assignment, container maintenance coordination and repositioning of empty container throughout IMLOG’s network is organised on a decentralised level as well. The underlying reason of the decentralised execution of these two functions can as well be found in the fact that each department controls a certain set of containers.

Container maintenance coordination involves the arrangements that have to be made for a container to be maintained. Main activities within this container management function includes determination of a container to be maintained, booking an appointment at the container maintenance shop, planning the pre- and post-transport, updating the information system et cetera.

The goal pursued within empty container repositioning is to prevent a shortage on empty container in a certain area when a surplus of empty containers in another area exists. Therefore this container management function is responsible for redistributing empty container to the location where they are needed the most. Empty container repositioning involves booking capacity at intermodal transport partners or at IMLOG’s road transport planners and informing the terminals about which containers are involved with the repositioning activity et cetera.

As is the case with container assignment, both other two decentralised container management function are currently performed manually, where ICT support the related processes in communication and data storage.

7.1.2 Centralisation is the key to other container management problems
The decentralised setup of the container maintenance coordination and empty container repositioning function causes problems in practice as well. For the same reasons to centralise the container assignment process, these processes can be improved as well by centralisation.

With container maintenance coordination the problem can be found in the unpredictability of the location of the container, especially the all-use containers. These containers are sent throughout Europe, but do not return that often back to the department that controls it. When maintenance has
to be performed, the container first has to be returned to the department that controls it. After the container is returned, the maintenance can be planned and executed. Especially the part of the process responsible for returning the container costs relatively much time, which results in the worst case that periodical maintenance due dates expire. By centralising the container maintenance coordination process containers can be more efficiently maintained. For instance containers have not to be returned to the controlling department, so coordination of the container maintenance can be performed based on the container’s network location. The closest container maintenance shop should be involved instead of the department’s regularly used container maintenance shop.

Currently if empty containers are being repositioned it is being performed incidentally on an ad-hoc base. This is caused by the fact that nobody has a clear understanding on shortages and surpluses of empty containers in IMLOG’s network. To be able to increase the availability of empty containers in IMLOG’s network with a clear understanding of the costs involved, empty container repositioning should be applied in a structural way. Centralisation of the empty container repositioning processes is the perfect approach in taking advantage of this opportunity.

7.1.3 Importance of an integral approach in container management

To take full advantage of centralised container assignment, the other two container management functions must be centrally organised as well. But why is it so important to centralise container assignment, container maintenance coordination and empty container repositioning all at the same moment? The explanation can be found in the relationship between the three container management functions concerning the availability of containers. Figure 7.1 shows the relationship between the three container management functions.

The container assignment process needs available empty containers in a certain area to successfully assign containers to shipment orders in that same area. The availability of empty containers in a certain area depends on the containers currently in that area and incoming empty containers from other areas resulting from the repositioning process. The availability of empty containers within the container assignment process depends as well on the number of containers that are subjected to the container maintenance coordination process. These containers cannot be used for assignment to a shipment order. In the same way the container maintenance coordination process influences the availability of empty containers for repositioning.

7.2 The design objective & problem design questions redefined

The design objective stated in the beginning of this report involves designing a measure based on a carefully selected improvement opportunity within IMLOG’s LLP concept. The previous part concluded to elaborate on reengineering the container assignment process. By taking the two related container management functions in the reengineering process into account as well enables to design an integral container management system. According this the earlier stated design objective can be refined into:

Design an integral container management system to solve related issues.
An integral container management system implies that the three container management functions (container assignment, container maintenance coordination and empty container repositioning) are covered by the design. In addition, two design problem questions on the design to made, mentioned already in the start of the report, can be further defined as well:

Which fundamental change(s) will occur with the adoption of the integral container management system?

What are important aspects when implementing the functional design of the integral container management system?

To which extend the design objective is fulfilled depends on the fulfilment of the requirements opposed on the functional design to be made. Answering the first problem design question follows after the functional design of the integrated container management system is completed. The second problem design question will be answered during the exploration of further steps towards the implementation of the functional design.
8 Requirements imposed on the design

Before the actual designing process can begin, requirements have to be identified to guarantee that the functional design will meet its original intentions. By confronting the design afterwards with the pre-formulated requirements, the quality of the design can be determined.

The requirements definition process starts with the identification of the motives of the proposed design task. This step provides insight in the design task’s needs and opportunities as well. From the previous chapters can be deducted that the need for the design task originates in IMLOG’s intention to improve its LLP concept. The first two parts of this report resulted in a set of improvement opportunities from which the container assignment process is chosen to elaborate upon. The previous chapter showed that it is important to include, besides container assignment, container maintenance coordination and empty container repositioning functionalities in the design process as well. Taking into account these three container management functions in the reengineering process will lead to a functional design of an integrated container management system.

By implementing this integrated container management system, issues and problems related to the three container management functions should be solved. In other words: container management should be executed more efficient by adopting the integrated container management system. For container assignment this includes that the number of underweight shipments will be reduced and less time should be spend on finding a suitable container to improve the service level towards the customer. Efficiency improvement for container maintenance coordination and empty container repositioning should lead to higher availability of empty containers against lower costs. Eventually this together will lead to an improvement of IMLOG’s LLP concept, which is in accordance with the motives of IMLOG to start this project.

Based on the motives, goals and opportunities related to the design tasks, the definition of requirements is the next step. These requirements will provide input for the development of the centralised container management system’s functional design. Because the deliverable of the design task is a functional design, requirements will be drawn up from a functional perspective. These functional requirements will be derived from the current practices on the three container management functions, which are taken into account in the integrated container management function. Insight in these current practises is obtained by conducting interviews and observation.

From a high level perspective the integrated container management system must be able to perform all three container management functions:

A. The system must assign suitable containers to a shipment order.
B. The system must coordinate container maintenance.
C. The system must coordinate empty container repositioning.

These three functions can be classified as high level functional requirements, but they are too vague to be able to develop an understandable functional design of the integrated container management system. Therefore each of the three main functional requirements will be decomposed into lower level functional requirements. Here fulfilment of lower level functional requirements contributes the fulfilment of the higher level functional requirements. For each of the main functional requirements within the integrated container management system, lower level functional requirements are identified below.

8.1 Container assignment functional requirements

Assigning a container to certain shipment order can be recognised as a process that is triggered by the existing shipment orders requesting a suitable container for loading in a certain location. Subsequently to be able to load this shipment an empty container must be sourced from a location closest to the loading location. The shorter the distance between the loading location and the empty container storage location, the lower the costs involved with loading the shipment order.
To determine which containers can be used for loading a shipment order, the location of each container must be known including its status. Only empty containers stored at fixed location can be considered for assignment to a shipment order. When an empty container is found close to the loading location of the shipment order, the suitability of the container must be determined. A suitable empty container is found when it fulfills the shipment order characteristics on for example the volume and the product type to be loaded. Therefore knowledge is needed to determine which containers are allowed to load certain product types for example. After a suitable empty container is found the container must be linked with the shipment order and should not be assigned anymore to another shipment order. The planner is instructed through the shipment order which container to use for a certain shipment order.

The following lower level functional requirements are identified based on the explanation above on the container assignment process:

1. The system must identify the shipment orders requesting a suitable container.
2. The system must identify the location of the container.
3. The empty container should be sourced as close as possible to the loading location.
4. The system must identify the status of the container.
5. The system must know which containers could be used for which type of shipment order.
6. The system must link a suitable empty container to a shipment order.
7. The system must prevent that containers that are assigned cannot be assigned to other shipment orders.

8.2 Container maintenance coordination functional requirements

Container maintenance coordination can be classified as a discrete based process, where the container is the main element of interest. Obviously containers are not being maintained continuously, but more in a structured and incidental way. Structured relates to the periodical checks and incidental involves reported container damage that has to be repaired. These two activities trigger the process of container maintenance coordination. When container maintenance is requested, the location of maintenance being performed must be determined. The maintenance location must be as closest to the location of the container to minimize the costs for transport to the maintenance location. Additionally container maintenance can generally only be performed when the container is empty. Therefore the status of the container has to be identified, before actual booking a maintenance appointment can happen. When the container maintenance location is determined and the container is empty, a maintenance appointment can be booked. Subsequently the transport of the container from the storage location to the maintenance location must be arranged. After maintenance is performed the transport from the maintenance location to the storage location must be arranged, which closes the container maintenance process. During the time a container is involved in the container maintenance process it must be prevented that will be assigned to a new shipment order.

Based on the elaboration on the container maintenance coordination, the following lower level requirements can be identified.

8. The system must determine when container maintenance activities are needed.
9. The system must determine the maintenance shop.
10. The system must identify the location of the container.
11. The system must identify the status of the container.
12. The system must book a container maintenance appointment.
13. The system must arrange the transport to and from the maintenance shop.
14. The system must prevent that containers waiting to be maintained or being maintained are assigned to other shipment orders.

8.3 Empty container repositioning functional requirements

As mentioned before empty container repositioning results from the imbalances of empty containers that exist between certain areas. These imbalances trigger the process that is responsible for the
coordinating the flows of empty containers to areas where they are needed most. To know where containers are needed the most, the demand for empty containers must be determined first. For this the number of shipment orders requesting a container must be compared with the number of available empty containers in a certain area. Combining these two numbers will result in a shortage or a surplus on empty containers in a certain area. To be able to determine the availability (shortage or surplus) of empty containers per area, the position and status of each container has to be known. Based on the knowledge on empty container shortage or surplus in a certain area, a plan has to be formulated that determines how empty containers are repositioned between the different areas. This plan involves an instruction on empty containers to be send from one to another location. Besides the surplus and shortages of container in certain areas, a priority between the areas is involved in developing the repositioning plan as well. Based on the repositioning plan capacity has to be booked at intermodal transport partners and terminals have to be informed before the physical repositioning activities can take place.

From this explanation on the empty container positioning process, the following functional requirements can be derived:

15. **The system must determine the need for empty containers per area.**
16. **The system must determine the number of shipment orders requesting an empty container per area.**
17. **The system must determine the availability (shortage or surplus) of empty containers per area.**
18. **The system must identify the location of the container.**
19. **The system must identify the status of the container.**
20. **The system must produce a repositioning plan.**
21. **The system must prioritise areas demanding empty containers.**
22. **The system must book capacity at intermodal transport partners.**
23. **The system must inform the terminals to tranship the containers.**
9 Functional design of an integral container management system

During the scoping phase of the design task the decision is made for centralisation of container assignment, container maintenance coordination and empty container repositioning into one system. With this approach these three functions are taken away from each disposition department within IMLOG and placed under the responsibility of the Centralised Container Management System (CCMS). Figure 9.1 shows left the current situation where these container management function are performed by the departments next to the departments other tasks. The right side of the figure shows the situation where the container management functions are transferred from the departments to the CCMS.

Centralising the three container management functions in a CCMS will contribute to solving the currently experienced issues related to container management. In addition the CCMS could bring several other advantages as well:

- Better overview of the containers including their status in IMLOG’s network.
- Improvement container availability due to efficient assignment and maintenance coordination.
- Improved customer service due to higher availability of containers.
- Improvement of effectiveness empty container positioning.
- Departments can focus on the coordination of logistics, which results in a higher efficiency of those departments.
- High potential of reduced container management costs when high level of automation applied.

Now the decision is made to centralise the three container management functions into one system, the functional design of the CCMS can be developed. The three functions will serve as starting point in describing the CCMS. First a short introduction on the fundamental processes and elements of the CCMS will be given. For each of the three container management functions a process description is provided. Following suggestions are made on the execution frequency of the related process. In the next step actors involved with the process are identified and their interfaces with the process are explained. The interactions, the process and the involved actors have with the information system are elaborated as well. Following key performance indicators, through which performance of the process can be measured, are proposed. Finally concluding remarks on the fulfilment of the requirements within design and the functional design as such are presented.
9.1 Centralised Container Management fundamentals

The three functionalities of the CCMS involve container assignment, container maintenance coordination and empty container repositioning. Figure 9.2 shows the three processes related to these functionalities, including the artefacts container database and shipment order. These two artefacts play a major role in the three processes, which will be explained further on.

The container assignment functionality is responsible for “matching” a suitable container to a certain shipment order, where the corresponding process is initiated with each new shipment order. For making a successful assignment a suitable container is searched for in the container database based on the shipment order characteristics. A “match” between a certain shipment order and a container is made when the shipment order characteristics suits the characteristics of a certain container fully.

Container maintenance coordination involves checking for each of the containers stored in the container database if maintenance is required by its maintenance due date. If the maintenance is required, the necessary arrangements are made to guarantee that the container will be maintained. The container maintenance coordination can also be initiated by incidental maintenance requests.

Whether empty containers are being repositioned depends on the demand and availability of containers in IMLOG’s network. Therefore the position and status (available or not) of each container is retrieved from the container database. Combining this information with the demand for containers in IMLOG network will results in empty containers being shipped to the locations where they are needed the most.

![Figure 9.2 - Key elements of the CCMS](image)

Container characteristics play a major role in all three container management functions, where shipment order characteristics only play a role in the container assignment function. For each container and shipment order its characteristics are stored in a profile, where the profiles together form a database. Table 9.1 represents the characteristics belonging to a shipment order profile, respectively a container profile.

<table>
<thead>
<tr>
<th>Container profile</th>
<th>Shipment order profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Container ID number (fixed)</td>
<td>Assigned container ID number (variable)</td>
</tr>
<tr>
<td>Load volume minimum (fixed)</td>
<td>Load volume (fixed)</td>
</tr>
<tr>
<td>Load volume maximum (fixed)</td>
<td></td>
</tr>
<tr>
<td>Container class (fixed)</td>
<td>Required container class (fixed)</td>
</tr>
<tr>
<td>Dedicated equipment class (fixed)</td>
<td>Dedicated equipment class (fixed)</td>
</tr>
<tr>
<td>Reload class last product (variable)</td>
<td>Reload class product (fixed)</td>
</tr>
<tr>
<td>Network location (variable)</td>
<td>Loading area (fixed)</td>
</tr>
<tr>
<td>Status (variable)</td>
<td>Loading date (fixed)</td>
</tr>
<tr>
<td>Maintenance due date (variable)</td>
<td></td>
</tr>
<tr>
<td>Last maintenance location (variable)</td>
<td></td>
</tr>
</tbody>
</table>

Each attribute of the shipment order profile, except the “assigned container number” is fixed and therefore cannot be changed by IMLOG. This is not the case with the container profile where “reload
class last product”, “network location”, “status”, “maintenance due date” and “last maintenance location” know a variable attribute level. For each of these variable attributes the level values have to be saved for every time a new shipment order is assigned to this specific container. If needed old values of these attribute levels can be recalled. The fixed attributes of a container can be recognised as container specifications, which cannot be changed. Depending on the type of attribute, different levels can be identified. By looking at the “reload class last product”, through this attribute can be determined whether reloading the container is allowed or not. This attribute could adopt each type of class, but it depends on the classes considered and the last product loaded with this specific container.

The status of the container is one of the most important characteristics of the container: it shows in essence how the container is deployed. Three different attribute levels can be distinguished when describing the status of a container: operational status (in use, blocked, repositioning), occupation status (full, empty, and assigned) and clean status (clean, dirty). Based on these three factors the following status profiles can be formed:

A. In use, full, unclean
B. In use, empty, unclean
C. In use, empty, clean
D. In use, assigned, unclean
E. In use assigned, clean
F. Blocked, full, unclean
G. Blocked, empty, unclean
H. Blocked, empty, clean
I. Repositioning, empty, unclean
J. Repositioning, empty, clean

A status profile where the container is in use, full and clean is in practice never possible. This counts as well for a container that is blocked and assigned at the same time. It should be prevented by the system that containers which are blocked are assigned to a shipment order.

The “network location” provides insight in the location of the container in IMLOG’s network. Two main levels can be distinguished: the container is in transit or stored at a terminal. When a container is not in transit, but stored at a terminal this attribute shows in which region and at which location the container is stored.

The last two variable attribute in the container profile are related to the container maintenance coordination of the CCMS. Both attributes know unspecified attribute levels; the maintenance due date and the last maintenance date depends on the location and the moment of the maintenance activities performed.

9.2 Container assignment design

9.2.1 Process description

Within the assignment process of a container to a shipment order three main steps can be identified. Based on the loading area and the loading date mentioned in the shipment order profile a container sourcing area, from which the empty container will be sourced, must be determined. Each container sourcing area consists out of one or multiple terminals. When the right container source area is determined, the search for a suitable container will start. If no suitable container on the shipment order’s loading date is found at this specific terminal, a terminal is selected which is one position lower on the priority list but still in the same area. The terminal priority list is based on the costs involved with storage of a container at a certain terminal. Containers stored on the most expensive terminal for storage are sources first. The activity of finding a suitable container on a terminal in a certain area repeats itself until a suitable container is found. The empty container repositioning functionality is responsible for the distribution of empty container between areas. Therefore containers will not be sourced from other areas than the terminals in the loading area.

When a suitable container is found, the shipment order and container profile will be updated. This contains adding the container ID number to the shipment order profile, changing the operational status and the reload class last product of the container. The three steps of this container assignment process are displayed in figure 9.3 in the next page.
Finding a suitable empty container can be classified as the key process in container assignment: this is where a successful match between the shipment order profile and the container profile must be found. Within the activity of finding a suitable empty container the focus is on minimising the number of containers that have to be cleaned. Therefore a distinction is be made between three types of container assignments, based on the clean status of the container.

This results in the occurrence of three different situations when assigning a container to a shipment order:

- **Reloading container assignment**: the assignment of reloading an unclean container is possible when the “reload class product” of the shipment profile is the same as the “reload class last product” mentioned in the container profile.
- **Clean container assignment**: when no reloading containers are available clean container will be assigned.
- **Unclean container assignment**: when both reload and clean containers are not available empty unclean containers will be assigned.

Reloading of containers has the highest priority due to the fact that cleaning costs can be saved. Clean containers can be found at terminals, because specific products require direct cleaning after discharging the product. Clean empty containers are first used, because the certificate of cleaned container is only valid for a certain period. Unclean containers can be used for reloading or cleaned after all when reloading is not applicable. The algorithm corresponding to the activity of finding a suitable container is elaborated in appendix I.

9.2.2 Pre-assigning empty containers: a viable option?

Execution of the three main container management processes is based on real-time container data: a container is no longer in transit and is stored at a certain location. This implies for the container assignment process that only non-moving containers are involved in the assignment process. Within container maintenance coordination this means that the corresponding process starts when the container is stored at a certain location. The repositioning of empty containers process only takes non-moving container into account as well. The fundamental reason to use only non-moving containers can be found in the unpredictability and capriciousness of logistics. This approach guarantees that containers are physically available for shipments that have to be loaded.

Within the proposed approach information on which container is assigned to a certain shipment order becomes available relatively late: at the end of the day for the shipment orders to load the day after. For having information on the assignment of a container to a certain shipment order earlier available, pre-assignment can be applied. This approach allows containers which are still in transit to be (virtually) assigned to certain shipment orders.

**Incorporation of the pre-assignment functionality in the CCMS**

The pre-assignment process can be seen as an extension to the assignment process which is described in paragraph 9.2. With finding a suitable container in a certain container source area empty containers heading (back) towards a certain storage location are taken into account next to the non-moving, stored containers. To enable this, two extra attributes has to be added to the container profile: “pre-determined storage location” and “expected arrival date”. Now each container source area consists out of containers that are physically and virtually present in this area. The levels of the two recently added container profile attributes should be created at the last moment a container is assigned to an order. The CCMS should take care of this in the container (pre-)assignment process.
In the “normal” situation containers are assigned a day before the shipment order has to be loaded. With applying the pre-assignment process containers can be assigned multiple days before the shipment order have to be loaded. Based on the load area and the loading date mentioned in the shipment order a suitable container is searched for among the containers which are virtually present in specific container search area. When a suitable container is found by executing the container assignment algorithm (see appendix I), the container status can be changed into “assigned”. At the same time the virtually assigned container ID number must be added to the shipment order profile. For this, the “virtually assigned container ID number” attribute has to be added to shipment order profile.

These three steps do not significantly differ from the “normal” container assignment process. But before the virtually assigned container can be used for loading the shipment order a final essential step must be made. This step involves checking whether the virtually assigned container is physically available at the pre-determined storage location. The shipment order cannot be loaded when the container is still on its way to the storage location. If the container is physically available, the “virtually assigned container ID number” can be changed into the “assigned container ID number”. If the virtually assigned container is not physically available at the pre-determined storage location, the shipment order will be placed in the pool of shipment orders searching for a suitable empty container via the “normal” container assigned process. Also the status of the virtually assigned container must be changed back in “empty” and the expected arrival date must be updated. Therefore the check whether a virtually assigned container is physically available should be executed at the beginning of the day prior to the shipment order’s loading date. Figure 9.1 summarises the above mentioned steps in a diagram.

Pre-assignment is currently not the right approach to follow

Through the application of container pre-assignment information on, for example, containers shortage in certain area can be identified in an earlier stage. There should be enough time to solve this shortage by repositioning empty containers. But is the introduction of container pre-assignment a feasible option?

Experience in IMLOG’s daily business leads to the conclusion that pre-assignment of the container will probably not deliver the desired increase of container control. This conclusion is mainly based on the unpredictability and capriciousness of logistics. Nowadays it occurs on a regular base that containers experience a delay in their arrival at a certain storage location of one or more days. Causes can be found in factors that cannot be controlled by IMLOG. In case of road transport delay results from for instance traffic jams. For intermodal transport IMLOG is relying on the services of intermodal transport partners. Delays in their services result in delays for IMLOG’s transports. IMLOG is not able to control the processes related to the services intermodal transport partners provide; therefore IMLOG find itself in a dependable situation. Other causes for delays in the movement of containers can be found in the load and unload process. More often than not it occurs that it takes multiple hours before loading can start due to a lack of capacity at the load location. The same counts for the delivery location, where waiting time occur regularly. Of course it can always occur
that an empty container arrives later than expected, but for a good functioning container preassignment system this situation should only be an exception.

Another reason for not implementing container pre-assignment in IMLOG’s business involves an expected, less optimal container assignment on shipment order level. Currently shipment order quantities are not standardised which also counts for the size of IMLOG’s containers. By assigning a container in an early stage to shipment order, likely another more suitable container could be assigned later on. The closer to the loading date the bigger the pool of empty containers is to find the most suitable container for this specific shipment order.

Pre-assignment of containers to shipment orders is highly depending on the reliable, up-to-date information. This counts especially for the expected date of arrival of an empty container at a certain storage location. When this information is not being updated in time, containers are falsely assigned to certain shipment order: this makes the pre-assignment of the container useless. From experience is known that container information is not always that reliable and held up-to-date, especially when (intermodal) transport partners are involved. Therefore the guarantee of having reliable, up-to-date information available should be one of the most important perquisites for implementing and operating a container pre-assignment system.

Concluding can be stated that pre-assignment should result in information being earlier available in the system. Currently the main prior condition on reliable and up-to-date information is not fully available, which makes it hard to fully rely on the pre-assignment approach. In addition the “normal” container assignment process has to be maintained next to the pre-assignment process as a back-up when containers do not arrive at the expected date at the terminal. Therefore the “normal” container assignment process will be the starting point in development of the CCMS. Preparatory steps can already be made in the development process of the CCMS to support the full introduction of the container pre-assignment process in the future.

9.2.3 Process execution frequency

In principle it should be enough to run the container assignment algorithm for all shipment orders requesting an empty container once a day for the next day, which is comparable with the current situation. Within IMLOG no containers will be assigned by other party, so no fear should exist that containers have been claimed for other shipment orders. Due to practical reasons it is recommendable to execute the algorithm around mid-afternoon. This gives planners the possibility to clean containers (if needed) and to make the necessary arrangements. By run the algorithm a few times a day understanding can be gained in the number of re-loaded containers, clean containers and unclean container. Also understanding can be gained on the number of shipment order which have already a container assigned to it. In case a lot of containers have to be cleaned for the next day, action can be taken to spread the number of containers to be cleaned for the next day.

9.2.4 Actors & interfaces

From the process description involved actors/artefacts, including their interfaces with the process, can be derived. Figure 9.4 shows the main actors/artefacts involved with the container assignment process. For executing the container assignment process the CCMS needs information (shipment order and container profiles) which is stored in the information system. In addition, it ads information to the information system in case of a successful container assignment is made. The planner uses the information from the information system to plan the shipments. Therefore the planner has to know which container should be used, where to pick it up, whether to clean it or not et cetera. The planner instructs the truck driver with the information gathered from the information system. In case of a not fully automated situation the truck driver informs the planner about the status and the network location of the container. Following the planner will update the information in the information system. In a more automated situation the truck driver should be able to update the information in the information system thru, for instance a board, computer. This interface is represented in figure 10.3 by means of a discontinuous arrow. In case of short term arrangements
and problems regarding container assignment the planner is able to directly communicate with the CCMS. This is represented thru a discontinuous arrow between the CCMS and planner. In this way it is possible to react relatively quickly if time is a critical factor.

The interfaces between the CCMS and IMLOG’s information system and between IMLOG’s information system and the planner should be fully automated thru EDI. This is also the case for the interface between the planner and the truck driver. The interface between the CMT and the planner will mainly be supported by telephone and e-mail due to the urgent and time critical character of the subject of communication. In case a truck driver is able to upload information into IMLOG’s information system an electronic interface is necessary to facilitate this.

### 9.2.5 Information system interaction

The container assignment process uses in its steps data from the shipment order and container profile stored in IMLOG’s information system. As could be recognised most of this data is fixed and cannot be changed. On the other hand one of the shipment order’s attributes and a few attributes of the container profile have a variable character and can be changed from time to time. Table 9.2 and table 9.3 shows which variable attributes can be changed, the options in the level of this attribute and who is responsible for making the change in attribute level.

<table>
<thead>
<tr>
<th>Shipment order attribute</th>
<th>Level</th>
<th>Responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assigned container number</td>
<td>Miscellaneous</td>
<td>CCMS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Container attribute</th>
<th>Level</th>
<th>Responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reload class last product</td>
<td>Miscellaneous</td>
<td>Automatically when full</td>
</tr>
<tr>
<td>Operational status</td>
<td>In use</td>
<td>CCMS</td>
</tr>
<tr>
<td>Blocked</td>
<td>CCMS</td>
<td></td>
</tr>
<tr>
<td>Occupation status</td>
<td>Full</td>
<td>Truck driver or planner</td>
</tr>
<tr>
<td>Empty</td>
<td>Truck driver or planner</td>
<td></td>
</tr>
<tr>
<td>Assigned</td>
<td>CCMS</td>
<td></td>
</tr>
<tr>
<td>Clean status</td>
<td>Unclean</td>
<td>Automatically when full</td>
</tr>
<tr>
<td>Clean</td>
<td>Truck driver or planner</td>
<td></td>
</tr>
<tr>
<td>Network location</td>
<td>Miscellaneous</td>
<td>Truck driver, planner &amp; terminal</td>
</tr>
</tbody>
</table>

When an attribute level mentions “miscellaneous”, it means that it can be anything. In case of the “reload class last product” this implies a pre-specified product class. “Network location” relates to a pre-defined location in IMLOG’s network or in-transit. “Automatically when full” implies that the
attribute level is changed when the occupation status is changed into “full”. Changing the level of the attribute could be done manually, but it is a good and easy opportunity to automate. Depending on the level of automation within the process, a truck driver, a planner or a terminal is responsible for changing certain attribute levels. For that the planner or the terminal is informed manually by the truck driver before changing the attribute level. In case no automation is applied the planner or terminal is responsible for changing the levels of certain attributes. When automation is applied, for instance thru board computer linked to the IMLOG information system, truck driver should be responsible for changing the attribute levels.

In an optimal situation changing the attribute’s level should be executed on a real-time base to guarantee reliable and up-to-date information. Automation could significantly contribute in preventing batching attribute level changes.

9.2.6 Key Performance Indicators
The container assignment functionality of the CCMS has as main objective to improve the current situation. To measure to which extend this functionality of the CCMS improves the situation, the following key performance indicators (KPIs) can be identified:

1. Number of re-loadings (which is directly related to the cleaning costs) (percentage of total number of container assignments)
2. Number of cleaned containers (percentage of total number of container assignments)
3. Number of shipment orders not having a container assigned (percentage of total number of container shipment orders/day)

9.3 Container maintenance coordination design

9.3.1 Process description
Due to the fact that IMLOG used specialised tank containers for its liquid chemical logistics, periodical checks are compulsory. Besides the periodical checks, incidental maintenance activities occur as well. Making the arrangement for the periodical checks and the maintenance will be further on mentioned as container maintenance coordination. This will be the second function fulfilled by the CCMS.

Three main activities can be distinguished within container maintenance coordination. First must be identified which containers are considered to be maintained by periodical checks or incidental maintenance. Second step is to plan and coordinate the physical maintenance. After the physical maintenance is executed the container profile must be update, which is step three. Figure 9.5 shows the sequence and the relation between these processes. The upper part of the diagram shows the main activities as mentioned above where the lower part focuses on the activities involved with the coordination of the maintenance.

Figure 9.5 – Activities in the container maintenance coordination process
The process of container maintenance coordination initiated by an incidental maintenance request or by a periodical maintenance database check. In case of an incidental maintenance request originates most of the time from a planner. The periodical maintenance database check compares the periodical maintenance due date with the current date and delivers the containers that need to be maintained.

The next step in the process is changing the operational status of the relevant container into “blocked”, so the container cannot be assigned anymore to a new shipment order.

Following, the coordination of the maintenance can start, with checking if the container is empty. If the container can is empty and stored at a specific storage location, a maintenance appointment can be booked at the container maintenance shop. Based on the storage location of the empty container a specific container maintenance shop is chosen for executing the maintenance, for which a *maintenance shop priority database* is used. It is assumed that each container terminal has at least one container maintenance shop at its disposal. This database is stored in IMLOG’s information system.

After a maintenance appointment is made, an internal transport order has to be generated. This internal transport order is comparable with a shipment order, but has already a container assigned. When the container arrives at the container maintenance shop, maintenance activities will be performed. It could occur that the container arrives at the container maintenance shop unclean. As a part of the maintenance the container is cleaned if necessary.

When the container is maintained the CCMS receives a notification from which an internal transport order is generated. This internal transport order takes care of the transport from the container maintenance shop to a certain terminal.

Last step in the process of container maintenance coordination is updating the container profile. This involves the container maintenance due date, the container last maintenance location and changing the operational status “in use”. Now the container is released back in the “pool” of containers “in use” and can be assigned to new shipment orders.

### 9.3.2 Process execution frequency

The process description of the container maintenance coordination functionality that the corresponding process can be triggered by two artefacts: an incidental maintenance request and a periodical maintenance database check. The periodical maintenance check results in two types of periodical maintenance requests. First type involves request related to container from which the periodical maintenance due date is expired and need to be maintained before the next the shipment can be loaded. This is also the case with incidental maintenance request. The second type of periodical maintenance requests involve the containers that can already been maintained with respecting the next periodical maintenance due date. This means that is possible to periodical check the container up to two months in front of the due date, through which a valid period of maximum fourteen months can be obtained.

For incidental maintenance and expired periodical maintenance requests it is necessary to change the container status into “blocked” as soon as possible. For optional periodical maintenance requests the container must be blocked from the moment the decision is made to maintain the container. A reason to maintain the container upfront could be that the container is in close proximity of IMLOG’s own container maintenance shop. This will save costs on transporting the container to the container maintenance shop.

Recommendable is that the maintenance database is checked on daily base as is the case for incidental maintenance requests. This step should be conducted before the container assignment plan is finalised, so containers could be “blocked” for assignment to a shipment order. Based on a list of containers needing incidental and/or periodical maintenance the succeeding container maintenance coordination steps must be executed.
9.3.3 Higher container availability through integral container maintenance planning

As mentioned before, the relation between the three main container management functions within the CCMS is based on the availability of empty containers. Container assignment requires suitable empty container to fulfill shipment orders. The availability of these containers is influenced by the number of containers “blocked” for maintenance and the efficiency of the reposition of empty containers. By having containers efficiently repositioned throughout the network the availability of empty containers is increased in areas where they are needed the most. Repositioning empty containers can be recognised as strategic container management function, compared to the container assignment functionality which is executed on a container level. The same strategic approach can also be adopted within container maintenance coordination functionality.

Centralising the container maintenance coordination enables to develop an integral container maintenance planning. This planning should lead to a situation where the availability of empty container is minimally influenced by containers being maintained: the objective with applying an integral container maintenance planning. This especially counts for periodical container maintenance, which can be planned when the due date is not yet expired. This is in contrast with incidental container maintenance requests which should be taken care of directly if the container is needed for loading a next shipment order.

Experience learned that the demand for empty containers changes monthly, but a yearly demand change cycle can be recognised. Therefore the integral container planning should be developed yearly, but where the maintenance on containers is planned per month.

Developing an integral container maintenance planning can be recognised as an optimisation assignment. The related process tries to find an optimal balance between the moment a container is being maintained and the duration of the maintenance. The following elements should be considered in the optimisation process:

- **Empty container demand**: ideally containers should be maintained in periods when they are not needed, to guarantee the availability of empty containers. In practice empty containers are always needed for loading shipments, therefore containers must be maintained in the period when the demand is on its minimum.

- **Container maintenance activities**: the availability of empty containers in total is not only influences by the number of containers being maintained, but also the period it is being maintained. The length of the container maintenance period depends on the type of container maintenance activity: the more extensive the activity is, the longer the container is not available. For instance extensive container maintenance activities must be planned when the demand for empty containers is on its minimum.

- **Container maintenance capacity**: the period it takes a container to be maintained is also depending on the capacity of the container maintenance shop. It makes no sense to plan in more containers for maintenance above the container maintenance shop capacity. This will only result in containers being longer not available for loading shipment orders.

The container maintenance planning will solely determine when containers should be maintained, not where. Due to the fact that containers are sent throughout Europe, it will not be possible to determine up front where the container will be on the moment it requests maintenance. Therefore the location where a container will be maintained will not be determined within the integral container maintenance planning.

Within the development of an integral container maintenance planning full advantage should be taken from the fact the containers can be maintained prior to the periodical maintenance due date. This type of maintenance is earlier classified as optional periodical container maintenance and provides flexibility for planning the maintenance. This is in contrast the incidental and expired periodical container maintenance requests which have to be taken care of as soon as possible if a next shipment must be loaded. When a container knows an optional periodical maintenance request
shipments orders can still be loaded by these containers, but within a certain time period the container has to be maintained.

Periodical container maintenance can, for instance, be conducted at one of IMLOG’s own container maintenance shops when a container is in close proximity before the periodical maintenance due date is reached. By adopting this approach the costs for transporting the container to the maintenance shop can be reduced, as mentioned earlier.

9.3.4 Actors & interfaces
As in the case of the container assignment functionality, an overview of the actors/artefacts involved with the container maintenance coordination can be made. Figure 9.6 shows the interfaces between the actors and artefacts involved with the container maintenance coordination functionality. The way the interfaces are used between the CCMS, the information system, the planner and the truck driver is completely identical as with the container assignment functionality. The last three actors/artefacts are involved in the transport to and from the container maintenance shop.

In case container maintenance, not periodical, is needed a planner informs the CCMS thru the information system. The container maintenance shop is added to the actor/artefact overview of the container assignment functionality for execution of the physical maintenance activities. The communication between the CCMS and the container maintenance shop consists of booking a maintenance appointment and inform each other on the proceedings and when the container is ready for pick up.

![Figure 9.6 – Actors & interfaces involved with the container maintenance coordination process](image)

The interfaces between the CCMS and IMLOG’s information system and between IMLOG’s information system and the planner should be fully automated thru EDI. This is also the case for the interface between the planner and the truck driver. The interface between the CCMS and the container maintenance shop should be ideally be fully automated as well. Depending on the willingness of the container maintenance shop such an interface can be applied. Other forms of interfaces between these two actors involve telephone, fax or e-mail. The interface between the CMT and the planner will mainly be supported by telephone and e-mail due to the urgent and time critical character of the subject of communication. In case a truck driver is able to upload information into IMLOG’s information system an electronic interface is necessary to facilitate this.

9.3.5 Information system interaction
In the process description of the container maintenance coordination functionality different container attribute levels are subject to changes. Those changes are essential for an optimal working system. Table 9.4 presents the container attributes that are involved with the container maintenance coordination, including the attribute levels and the actor that is responsible for the change in attribute level.
The network location of a container changes when a container to be maintained is transported between the terminal and the container maintenance repair shop. Just as within the container assignment functionality the truck driver, the planner or the terminal is responsible for changing the network location, depending on the level of automation. Every time a container is maintained, the maintenance due date and the last maintenance location must be updated. This enables to recall historical information on the maintenance performed on a certain container.

<table>
<thead>
<tr>
<th>Container attribute</th>
<th>Level</th>
<th>Responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational status</td>
<td>In use</td>
<td>CCMS</td>
</tr>
<tr>
<td></td>
<td>Blocked</td>
<td>CCMS</td>
</tr>
<tr>
<td>Clean status</td>
<td>Unclean</td>
<td>Automatically when full</td>
</tr>
<tr>
<td></td>
<td>Clean</td>
<td>Truck driver or planner</td>
</tr>
<tr>
<td>Network location</td>
<td>Miscellaneous</td>
<td>Truck driver, planner &amp; terminal</td>
</tr>
<tr>
<td>Maintenance due date</td>
<td>Miscellaneous</td>
<td>CCMS</td>
</tr>
<tr>
<td>Last maintenance location</td>
<td>Miscellaneous</td>
<td>CCMS</td>
</tr>
</tbody>
</table>

9.3.6 Key Performance Indicators

To be able to measure the performance of the container maintenance coordination functionality within the CCMS key performance indicators (KPIs) have to be defined. These KPIs provides insight in the efficiency and the effectiveness of the process of container maintenance coordination. The following key performance indicators are defined:

1. Availability of container (percentage containers from which the operational status is “in-use”)
2. Number of containers not maintained but in use (percentage of total number of containers)
3. Number of containers “blocked” and waiting to be maintained (number/day)
4. Average time of container at container maintenance shop (days)
5. Costs involved with the transport from and to the container maintenance shop (Euro/container maintenance coordination cycle)

9.4 Empty container repositioning

9.4.1 Process description

Repositioning the empty containers involves three main activities. First must be determined where in the network a surplus of empty containers exists and where containers are needed. The next step involves the development of a plan which describes which empty containers should be send to which location: the repositioning plan. Following step involves the physical logistics activities and the related coordinating activities. Figure 9.7 shows these three main activities in the upper part of the diagram. The lower part of the diagram goes into more detail on the activities related to the coordination of the repositioning.

It can be assumed that repositioning is driven by a mismatch between supply and demand of empty containers in a certain region. Especially the case when the supply cannot fulfil the demand urges for repositioning. The level of empty containers supply can be measured by checking the information system on the “network location” of each container which is stored in the container profile. The level of demand can be derived from the number of shipment orders in that same region thru. In the case a surplus of empty containers in a certain region exists, this container could be send to a region where a shortage on empty containers exists. The other way around is possible as well: empty containers have to be sources from other regions (with a surplus). This sub-process results in an overview of the supply or demand of empty containers for each region in IMLOG’s network: the container surplus and shortage matrix.

The container surplus and shortage matrix does not provide a plan how to reduce or solve the imbalances in empty containers in certain regions. This plan is being developed in this next activity:
the development of a repositioning plan. In other words: which empty containers are being shipped from which terminal to another terminal.

Different parameters influence the decision on how to reposition empty containers throughout IMLOG’s network. When defining these parameters it is important to look at the motive for repositioning: increase availability of empty containers where they are needed most. Availability is service level related and therefore can be concluded that repositioning is driven by the need to improve service. Parameters influencing the repositioning of empty containers are costs, lead time and the availability of connections between certain locations in the network.

The repositioning plan evolves into a network load matrix which shows which containers have to be sent from one terminal to another to reduce or solve the imbalance of empty containers in IMLOG’s network. More information on the planning of empty container repositioning can be found in appendix J.

The last step in the repositioning process is making the arrangement for the physical transport of the containers between the terminals in IMLOG’s network. This process is driven by the network load matrix which determines which containers have to be sent between terminals. Based on this matrix the process starts with booking the transport capacity at the intermodal transport partner. Next step is to change the operational status of the container so it cannot be assigned to a shipment order anymore. Subsequently the terminals have to be informed by means of a(n internal) terminal order. This order is communicated with the involved terminals thru IMLOG’s information system. Following, the container will be physically transported from the origin terminal to the destination terminal. When the container arrives at the destination terminal, the container is ready to be assigned to a new shipment order.

9.4.2 Process execution frequency

The empty container repositioning process is triggered by the sub-process that determines the need for repositioning empty containers throughout IMLOG’s network. Erera et al (2005) identified three different planning strategies in repositioning empty containers, based on the frequency of routed operated, routing and batch size:

- **Weekly repositioning**: this strategy suggests that only once a week a repositioning plan will be developed and executed the week after. The most important driver in this strategy is the costs of repositioning. Therefore only certain routes between terminals will be taken into account.
- **Bounded daily repositioning**: it is allowed to repositioning containers on a daily base, but with some restrictions. An example of a restriction involves the accumulation of a predetermined number of containers before they will be sent in a batch from one to another terminal.
- **Unbounded daily repositioning**: This strategy involves no restrictions at all: on a daily basis containers are being sent (not accumulated) from one terminal to another.
Of course there are some hybrid strategies to think of, but depending on the wishes and needs of IMLOG a certain strategy can be adopted or developed. Due to the relatively long transit time and the non-daily operated services between the terminals in IMLOG’s network it is recommendable to reposition empty containers on weekly base. This gives the opportunity to send empty containers in a batch which could have financial benefits. It also prevents that containers are sent day one from terminal a to terminal B and the next day to terminal C which results in higher costs than when a container was directly send from terminal A to terminal C.

9.4.3 Actors & interfaces
Compared to the other two functionalities within the CCMS, the empty container repositioning functionality involves two new introduced actors. First new actor is the intermodal transport partner at whom intermodal transport capacity is booked. Second new actor involved is the terminal which is responsible for the transhipment of the empty containers onto and from the boat or train. Figure 9.8 displays the CCMS and IMLOG’s information system together with the two new actors and their relationships with each other.

The interfaces between the CCMS and IMLOG’s information system, between IMLOG’s information system and the terminal should be fully automated by use of EDI. The interface between the CCMS and the intermodal transport partner should ideally be fully automated as well. Depending on the willingness of the intermodal transport partner such an interface can be applied. Other forms of interfaces between these two actors involve telephone, fax or e-mail.

9.4.4 Information system interaction
Within the empty container repositioning functionality two variable container attributes are subject to change: the operational status and the network location. When an empty container must be repositioned, it cannot be used for assignment to a shipment order. Therefore the container is no longer “in use”. The CCMS is responsible for changing the operational status of a container into “repositioning” in case of repositioning. The network location of a container changes when it is repositioned from one terminal to another. The terminal is responsible for changing the network location when leaving and arriving at the terminal. Table 9.5 summarises above mentioned change in attribute levels and the related responsible actor.

Table 9.5 – Changes in container attribute level due to the container maintenance coordination process

<table>
<thead>
<tr>
<th>Container attribute</th>
<th>Level</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Operational status</td>
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<td>CCMS</td>
</tr>
<tr>
<td></td>
<td>Blocked</td>
<td>CCMS</td>
</tr>
<tr>
<td></td>
<td>Repositioning</td>
<td>CCMS</td>
</tr>
<tr>
<td>Network location</td>
<td>Miscellaneous</td>
<td>Terminal</td>
</tr>
</tbody>
</table>

9.4.5 Key Performance Indicators
To measure the efficiency and effectiveness of the empty container repositioning functionality within key performance indicators (KPIs) can be defined. These scores on these KPIs can be used as well for comparing the situation with and without an empty container repositioning functionality. The following KPIs are defined:

1. Number of postponed loading date due to no availability of suitable container (by day)
2. Number of loaded volume is less than requested on shipment order due to no availability of suitable container (by day)
3. Number of empty containers repositioned (number/week)
4. Number of empty container not assigned after repositioning (number/week)
5. Shortage of empty containers in a specific area (number/day)
6. Surplus of empty containers in a specific area (number/day)
7. Costs involved with repositioning empty containers (€/week)

9.5 Concluding remarks on the presented functional design

Now the functional design of the CCMS is presented, the quality of the design can be determined by checking to which extent the design fulfils the requirements imposed on the design. Eventually insight can be obtained to which extent the functional design is able to solve issues. First step is to determine the fulfilment level of the functional design presented on the functional requirements stated in chapter eight. First the fulfilment of the three main functionalities within the integrated container management system will be addressed. Following for each of the functionalities the fulfilment of the related functional requirements will be discussed. Concluding the way the issues should be solved by the implementation of the proposed functional design will be discussed followed by a remark on the functional design itself.

9.5.1 Fulfilment of the main functionality requirements

Scoping the design task resulted in the requirement that container assignment, container maintenance coordination and empty container repositioning must be considered in the functional design. This requirement can be divided in three separate ones, of which the level of fulfilment will be elaborated below.

A. The system must assign suitable containers to a shipment order.
   In paragraph 9.2 this requirement is fulfilled through the developed process that assigns a container to a certain shipment order. Before a container will be assigned, first a suitable container must be found. A suitable container is found when a match is found when comparing the shipment order characteristics with the container characteristics.

B. The system must coordinate container maintenance.
   This requirement is fulfilled in paragraph 9.3 by the development of a process that takes care of coordination the maintenance on containers. With the development, process steps are identified, including related interfaces with actors and artefacts involved with the maintenance on containers.

C. The system must coordinate empty container repositioning.
   Paragraph 9.4 shows that this requirement is fulfilled in the functional design of the integrated container management system. A process is developed that is responsible for reposition empty containers to areas where they are needed the most.

Concluding: the three above mentioned requirements regarding the integrated container management functionalities are fully fulfilled within the functional design made.

9.5.2 Fulfilment of the container assignment functional requirements

Detailed container assignment functional requirements are derived from the requirement to include the container assignment functionality in the integrated container management system. The fulfilment of these requirements in the functional design made in paragraph 9.2 can be explained as follows:

1. The system must identify the shipment orders requesting a suitable container.
   Shipment orders requesting a container serve as input for the container assignment process. These shipment orders are stored as such in IMLOG’s information system and retrieved from it when the container assignment process is initiated.

2. The system must identify the location of the container.
   Identification of the container’s location can be achieved by consulting the appropriate container profile which is stored in IMLOG’s information system. Therefore an interface between the CCMS and IMLOG’s information system is included in the functional design.
3. **The empty container should be sourced as close as possible to the loading location.**
The loading location of a shipment order lies inside a pre-determined loading area. Based on this loading area, which is mentioned in the shipment order, the area from which the container will be sourced is determined. This prevents that containers are being sourced far away from the loading location.
Within the container source area it can be more efficient to source a container from a storage location further away from the loading location than one in closer proximity. The reason can be found in the fact that storage of (empty) containers at a third party storage location is more expensive than at IMLOG’s own terminal. This results in a situation where extra costs for storage at a third party storage location are being neutralised by the increase in costs for further away sourcing.

4. **The system must identify the status of the container.**
Only empty containers can be assigned to a shipment order, else wise loading of the shipment will not be possible. To be able to assign an empty container the system must know which containers are empty and which are not. Therefore the container profile, stored in IMLOG’s information system, knows an attribute called “status”. The corresponding attribute level of this attribute can be obtained by consulting IMLOG’s information system.

5. **The system must know which containers could be used for which type of shipment order.**
Not every container can be used for each shipment: the shipment order quantity must fit the container and the container must be approved for shipping this specific order. For this the container profile contains a container class attribute, which should match the required container class in the shipment order profile.

6. **The system must link a suitable empty container to a shipment order.**
After a suitable empty container is found, the last step of the described container assignment begins: the container is being linked to a certain shipment order. The container status will be changed into “assigned” and the container number will be added to the shipment order profile.

7. **The system must prevent that containers that are assigned cannot be assigned to other shipment orders.**
When a container is linked to a certain shipment order, the container status mentions that it is no longer available. The container assignment algorithm takes only available containers into account, so empty containers cannot be assigned twice at the same time.

All functional requirements related to container assignment functionality are all fulfilled within the design made, except one. The third requirement is not completely fulfilled: besides the distance, the location where a container is stored determines influences costs as well. A balance should be found between the distance and the storage costs of a container at a certain terminal to keep costs as low as possible.

9.5.3 Fulfilment of the container maintenance coordination functional requirements
Based on the higher level functional requirement on container maintenance coordination detailed functional requirements are formulated. The fulfilment of these requirements in the functional design presented in paragraph 9.3 can be elaborated as follows:

8. **The system must determine when container maintenance activities are needed.**
The functional design of the container maintenance coordination process takes different triggering factors into account. Incidental maintenance request cannot be controlled by the CCMS and always have to be taken care of. Periodical container maintenance can in principle be controlled and planned by the CCMS. Periodical container maintenance requests follow from a database check on the periodical maintenance due date. For this the attribute “container maintenance due date” is included in the container profile.
9. **The system must determine the maintenance shop.**
   Determination of the container maintenance shop is included in the design of the process. The choice for a certain container maintenance location is based on the maintenance shop priority database, which is stored in IMLOG’s information system.

10. **The system must identify the location of the container.**
    By consulting the container profile in the IMLOG’s information system, the location of the container can be retrieved thru the attribute “network location”.

11. **The system must identify the status of the container.**
    The status of the container can be retrieved from IMLOG’s information system by consulting the container attribute “status” which is stored in the container profile.

12. **The system must book a container maintenance appointment.**
    After the container maintenance location is determined, the container maintenance coordination process precribes a maintenance appointment must be booked. For this an interface is drawn up between the CCMS and the container maintenance location.

13. **The system must arrange the transport to and from the maintenance shop.**
    An internal transport order generated in the designed process takes care of the transport between the container storage location and the maintenance shop.

14. **The system must prevent that containers waiting to be maintained or being maintained are assigned to other shipment orders.**
    According the process design the container status will directly be “blocked” to prevent that the container will be assigned to a new shipment order. This also counts for container urging for periodical maintenance.

Based on the requirement fulfilment explanation above it can be concluded that the functional design of the CCMS made fulfils all functional requirements regarding the container maintenance coordination functionality.

9.5.4 **Fulfilment of the empty container repositioning functional requirements**

The fulfilment of the empty container repositioning design’s functional requirements in the design presented in paragraph 9.4 can be amplified as follows:

15. **The system must determine the need for empty containers per area.**

16. **The system must determine the number of shipment orders requesting an empty container per area.**

17. **The system must determine the availability (shortage or surplus) of empty containers per area.**
    The process of repositioning empty containers within IMLOG’s network starts with drawing up the container surplus and shortage matrix. This matrix provides insight in where in IMLOG’s network containers are needed and where these could be sourced from. The information in the matrix originates from the container are shipment orders profiles stored in IMLOG’s information system.

18. **The system must identify the location of the container.**
    By consulting the container profile in the IMLOG’s information system, the location of the container can be retrieved thru the attribute “network location”.

19. **The system must identify the status of the container.**
    The status of the container can be retrieved from IMLOG’s information system by consulting the container attribute “status” stored in the container profile.

20. **The system must produce a repositioning plan.**
    Based on the container surplus and shortage matrix and preferences of IMLOG, a repositioning plan can be formulated. This plan will result in the network load matrix, which precribes which containers have to be send from where to where in IMLOG’s network.
21. **The system must prioritise areas demanding empty containers.**

IMLOG’s preferences provide the input for prioritising between areas where empty container must be send to. Based on these preferences the repositioning plan will be drawn up.

22. **The system must book capacity at intermodal transport partners.**

The empty container repositioning process takes care of booking the capacity at intermodal transport partners based on the network load matrix. For this an interface between the CCMS and the intermodal transport partners is created.

23. **The system must inform the terminals to tranship the containers.**

After capacity for repositioning empty container is booked at intermodal transport partners terminals are informed accordingly. For this, a terminal order is created which is communicated thru IMLOG’s information system.

All functional requirements formulated for the empty container repositioning functionality are met in the design made following the fulfilment explanation above.

9.5.5 **Will identified issues be solved by the functional design proposed?**

In the first chapter of the design part the design task was scoped: container management functions must be centralised in the design to be made. Container assignment, container maintenance coordination and empty container repositioning were considered to have the most improvement potential by through centralisation. Issues mentioned with container assignment were the number of underweight shipments and the time consuming, inefficient applied procedure. Issues related to container maintenance involve the high chance of expired periodical maintenance due date and here as well the time-consuming applied procedures. For repositioning empty containers throughout IMLOG’s network no structural procedure is applied: repositioning is being performed on an ad-hoc base without having full knowledge on empty container shortages and surpluses.

Now the functional design is made, to what extend will the above mentioned issues be solved when the functional design will be implemented? In this stage it is hard to predict in numbers to what extend these issues will be solved, although several remarks can be made how these issues will be solved:

- **Exclusion of strategic personal behaviour:** by centralisation of the three container management functions strategic personal behaviour will be eliminated. Transport planners are no longer responsible for containers and cannot “hide” containers anymore from other container planners for own purpose. Due to this containers will not any longer be stored for a few days by transport planners: the container occupancy rate will increase.

- **Number of underweight shipments decrease:** according the proposed process for container assignment solely containers will be assigned to a shipment orders that are able to transport the requested weight of a certain product. Of course exceptions will remain, but the number of shipments of which the transported weight is less than requested will be decline.

- **Efficiency improvement through structured approach:** the centralisation of the three container management functions in the CCMS will require a structured approach to be successful. Especially the empty container reposition efficiency will experience a positive effect from this structured approach. This structures approached can be recognised in the processes and the procedure related to the three container management functions included in the CCMS.

- **Efficiency improvement through automation:** currently the processes related to the three main container management functions are manually executed. The proposed functional design enables improve the efficiency of the container management process through automation. Automation of these processes will result in fewer people needed for the execution of these processes. The people employed in the CCMS will have a more monitoring and steering functions then an executory function: all executor processes are automated.

Based on the functional design presented further steps can be taken to quantify the suggested efficiency improvements. These steps will be a part of further steps in the development process: paragraph 10.5 elaborates on these steps to take towards full implementation.
9.5.6 Long distance transport orientation in the proposed functional design

The previous paragraph showed that the functional design made fulfils the requirements formulated earlier in the design process to great extend. Nevertheless one important remark on the design can be stated. This remark will not elaborate on the design details, but are more subject to the overall design with its three main functionalities.

The design is mainly long distance shipment oriented: it fits best intermodal and long distance road transports. The relatively long transit times related to these two types of transports enables to plan the containers rather efficient. From practical experience is known that multiple short day trips are performed with one single container. This is not yet fully supported by the functional design made; the assumption is made that a container will only be loaded once a day. Therefore further development of the design presented is essential for efficient containers use in short (day) trips.
10 Important topics towards implementation

With the conceptual design formulation of the CCMS in the previous chapter, the reengineering process does not come to an end. Therefore this chapter shall identify several topics that are important for further development and implementation of the CCMS. These topics can be classified into hard and soft topics. Hard topics include the resources needed for the development and implementation of the CCMS, the costs involved with these resources and the adaption of a Decision Support System. The soft topics are related to managing the development and implementation of the CCMS, where process change management plays a major role. This chapter concludes in a step-by-step approach towards a full operational CCMS. This approach should give a first insight in the steps to take in the development and implementation process of the CCMS.

10.1 Resources

A distinction can be made between resources used during the development/implementation phase and the operational phase of the CCMS. According Verona (1999) the development phase mainly human and knowledge resources are used. The persons which are a member of the project team (in this case the CCMS team) use their internal and external integrative capabilities to increase their knowledge level on the subject of interest. To come up with a successful design the project team should have an interdisciplinary character. Persons specialised in container management from IMLOG’s disposition department, decisions support systems specialists even as information system and (electronic) interface specialist should be part of this team. This group of persons are steered by one or more business reengineering specialists who monitor and controls the development and implementation process. Of course other types of resources are involved with the development of the CCMS, but have a supporting character. Physical resources, like computers et cetera, and information resources are typical resources that support the development process. By bundling these resources in a specific way will lead to development of the CCMS.

Operating the CCMS requires a bundling a broader set of resources. Physical resources represent the physical characteristics of the CCMS. First a location is needed which houses other physical resources, like an office. Secondly ICT hardware (computers, telephone et cetera) is needed to facilitate the container management processes and the interfaces between the CCMS and the involved actors. Human resources are needed to execute, control and monitor the container management processes. Each of the three container management function should have at least one responsible person, but it depends of the level of automation applied in the processes related to the three container management functions. From the design description of the CCMS can be concluded that those processes are highly depending on information resources. The most important information resource of the CCMS is IMLOG’s information system; without a proper functioning system it will be impossible to guarantee an optimal performing CCMS.

10.2 Costs

Costs related to the CCMS are based on the resources involved. Therefore costs can be assign to the development/implementation phase and operational phase. During the development and implementation phase the emphasis will be on costs related to the deployment of human resources. These human resources are responsible for making the design of the CCMS and translating this design in real practice. Important factor for the determination of the costs involved with the human resources are the number of persons involved with the project and the time period that those persons are deployed. This has as well a direct link with the level of automation applied in the CCMS and the use of a decision support system. After the CCMS is developed implementation is the next step. Here the emphasis is on costs related to the physical resources. Investments in ICT hardware is needed to realise the infrastructure that is needed for operating the CCMS. Depending on the level of automation within the CCMS heavy costs are involved with the realisation of the (electronic)
interfaces between the CCMS and other parties. During the implementation of the CCMS human resources, which fulfil a function in the CCMS during in the operational phase must be sourced as well. Finding the right persons, with the right qualifications involves resources, costs and time. Costs during the operational phase of the CCMS are mostly related to human resources. Labour costs result from the persons that are on a daily base responsible for executing, controlling and monitoring the processes within the CCMS. Here as well the level of automation and to what extend a decision support system is applied influences the height of the labour costs. The CCMS itself falls under the responsibility of the IMLOG’s overall disposition manager, which brings costs as well with it. Next to this, the information system and the (electronic) interfaces have to be maintained during the operational phase as well, which results in operational costs as well. This type of costs is related to (the use of) information resources.

10.3 Decision Support System: the key to efficiency improvement

From the description on the current container management within IMLOG can be derived that all three functions are executed manually, but with support of IMLOG’s information system. When centralising these three functions in a CCMS, automation to a certain extend could be helpful in improving the efficiency of the processes operated. A full automated operation of the three main container management processes will not be possible due to the capriciousness and unpredictable character of (logistics) environment it operates in. One or more persons within the CCMS have to make the final decisions and must be able to intervene if necessary. On the other hand certain processes related to the three container management functions can be automated. Therefore a decision support system can be proposed which will provide support to the decision making persons of the CCMS. Besides improving the efficiency of the container management unit, a decision support system makes the process less subjective to behaviour of individuals.

![Figure 10.1 - Functional components of a Decision Support System (Ariav & Ginzberg, 1985)](image)

A decision support system can be described according the functional components mentioned by Ariav and Ginzberg (1985). Figure 11.2 shows these functional components, where the arrows represent the interfaces between these functional components. First there is a user of the decision support system that uses it for certain task. In some kind of way it communicates with the system by giving it input in form of parameter settings and assignments. The decision support system communicates with the user thru dialogue functionality as a part of the dialogue management. The dialogue management is able to transform the request of the user into a set of needed information. This information is being subtracted from the model and data functionality or a combination between both. The data management functionality is responsible for subtracting only the needed
information from external data sources thru a query function. The model functionality involves optimisation algorithms specially developed according the need of the user. Through the dialogue function the model receives (parameter) information from the user. Other input for the model is supplied by an external data source through the data management function which selects only the information needed.

For each of the container management functionalities a separate decision support system can be developed and implemented. By following an integrated approach a more efficient and effective decision support system can be obtained.

All three container management functions have the container as the main object, which interacts with other objects like for instance a shipment order. Therefore an object oriented decision support system is highly recommended to develop.

10.4 Process change management

After the design is made, it must be implemented before it will be operational. This implementation is not a simple procedure which can be taken without spending much attention. Taking the design of the CCMS into account and confronting it with the current situation, it is obvious that a lot have to be changed. These changes affect every level of the current way of working, which can results in a lot of resistance in the organisation (Waddell & Sohal, 1998). First the organisational structure of IMLOG’s disposition department will change due to the fact that container management functions are centralised. Second, the working procedures will change by the involvement of a decision support system. Third, a decision support system requires changes in the IMLOG’s current information system. All these changes have to be managed thru organisational, technical and people strategies so the design will be finally implemented and operates as expected (Aladwani, 2001). To overcome resistance in the implementation phase of the CCMS, people strategies to create support are of major importance. This is where the major challenge in change management can be found (Grover, 1999).

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![Figure 10.2 - Framework for managing change (Aladwani, 2001)](image)

Aladwani (2001) developed a framework which guides the change process to handle resistance most effectively, see figure 10.2. This framework could be applied when implementing the CCMS. The first step in the framework involves the identification of the actors involved with implementation of the CCMS, which includes their stake in the project as well. In this step insight is obtained in the possible resistance of the actors involved. According Sheth (1981) resistance for projects like the CCMS is based on mainly two factors which interact: perceived risk and habits. Perceived risk involves the risk
someone relates to the changes which results from the (implementation of the) CCMS. These changes involve the current way of working (the habit), which involves routines. Wadell and Sohal (1998) go in their paper a bitter deeper on the factors that are related to perceived risk and habit. They identified rational and non-rational factors, political factors and management factors as most important. In the case of implementing the CCMS at IMLOG’s disposition division political and management factors will play a major role.

All the information (knowledge) together serves as input for the second step in the framework: the strategy implementation phase. This phase applies a three level adoption processes: “think”, “feel” and “do”. Think involves strategies that create awareness on the changes related to the project among the actors involved. Communication can be seen as the most important tool to create awareness. Communication can be deployed from an active perspective thru conversations, or passive thru for instance written information. In this way the involved actors can get a used on the idea of the changes to come. The feel level involves direct influencing the attitude of the actors towards the CCMS. Key is to provide those actors inside in what their gain is in the CCMS, with a differentiation on approaching different actors. The last stage of the strategy implementation phase involves the last steps before real implementation of the project. Therefore a majority of the actors must be in favour of the CCMS. Certain key actors can play an important role in convincing other actors to be pro implementing the CCMS. Change management does not stop after the CCMS is implemented; evaluation thru monitoring and controlling of the change process is needed. In this way steering can be applied to minimise resistance during implementation, but as well during the operational phase.

10.5 Next steps in the development approach

The four above mentioned topics are considered important during the development of the CCMS towards implementation, but do not provide insight in the steps to take from now on. Talwar (1993) suggests a framework that enables to develop the functional design towards an implementation plan, see figure 10.3. IT and automation is an important aspect within the processed of the CCMS, therefore proposed framework suits perfectly due to its special attention for IT.

The framework provides insight in the elements that are needed to come to an implementation plan. Development of the elements “Structure” and “Process” has started by the functional design made in the previous chapter. This design has to be further detailed to result in the business architecture and the IT delivery plan.

The framework presented does not elaborate on how to realise these elements. Therefore the following steps should be considered towards implementation of the CCMS:

1. **Compose a project team**: when the decision is made for further development of the CCMS, first step to take is to form a project team. This team will be responsible for the project until it is fully operational. Recommendable is to include at least one person of each involved discipline: container expert, transport planner, information system specialist, IT specialist,
terminal manager and container maintenance shop manager. Including different persons from different disciplines will contribute to the creation of support for and reduced resistance against the project among the involved employees. Several additionally other persons are needed being responsible for the development (process) of the CCMS in total: the project management team. Their task involves the management of the development process which includes combining the information from the specialist and monitoring the progress of the project and intervenes if necessary. The persons in the project team should in this first stage of the project be sourced from within the company, especially the specialist. Positions on the management of the project do not have to be sourced definitely from within the company. For instance involving a management consultant could be a good option.

2. **Perform first feasibility check**: by having a project team formed, it is possible to determine the potential of the CCMS from different perspectives. When the potential of the project is valued high enough, the project can be considered to be feasible. This enables to proceed to the following step in the development process.

3. **Define project approach**: next step in the development process involves the definition of the project management aspects. This involves scheduling the project steps, determination of budgets for the development process, defining a progress measurement method and an agreement on the responsibilities of each project member.

4. **Create cross-functional teams**: cross-functional teams must be deployed in obtaining the elements mentioned in the framework above. Thru the use of cross-functional teams complexity is easier to capture compared with pure mono-functional teams. For instance the IT delivery plan is influenced by such a high amount of factors (transport planning, container location et cetera), that involving specialist on certain disciplines prevents relations being forgotten. The cross-functional teams will consist of the members of the project team, but also specialist from outside the company. For instance for developing certain technical interfaces innovative specialists could be involved.

5. **Develop a detailed business architecture design & IT delivery plan**: Each cross-functional team is responsible for developing an aspect of the business architecture and the IT delivery plan, by creating the corresponding elements mentioned in the framework. Within the development of each element detailed costs estimation is made. The costs estimations of all elements together provide insight on the order of magnitude of the budget needed for the proposed business architecture and the IT delivery plan. The project management team is responsible to support and monitor those cross-functional teams during the development process. Combining the information of all cross-functional teams together into the business architecture and the IT delivery plan is the responsibility of the project management team as well.

6. **Perform second feasibility check**: now the business architecture and the IT delivery plan is developed a second feasibility check can be performed. This involves whether the proposed CCMS has still enough potential to be implemented when taken into account the detailed design including the related estimated costs. This step will conclude in a termination of the project or a further going development process.

7. **Develop an implementation plan based on the proposed business architecture and IT delivery plan**: a positive outcome on the second feasibility check will result in an implementation plan being developed. The elements left of the “implementation plan” element in figure 10.3 guide the implementation plan’s development process.

8. **Implement the CCMS**: the developed implementation plan should lead to a smoothly transition from the current to the new situation where the CCMS is being operated. Of course the implementation of the CCMS should be carefully monitored to be able to adjust the implementation plan if necessary. Especially after an operational period of a few months the processes within the CCMS should be monitored and fine-tuned if necessary.

These eight steps provide briefly the main steps to take towards an operational functioning CCMS. Of course there are numerous of small steps to take within each of the eight steps defined up until the
lowest thinkable level. Further information on which questions could be considered in each step of the development process can be found in Grover and Malhotra (1997).
Conclusions

This report started with an introduction explaining that IMLOG encountered after almost two years several issues in the LLP concept it provides for PRODA. This formed the motive of this project to identify opportunities to improve IMLOG’s LLP concept followed by further elaboration on these improvement opportunities. The following design objective was formulated in this project:

*Design an improvement measure based on a carefully selected improvement opportunity within IMLOG’s LLP concept.*

Looking backwards this design objective is fulfilled by the design of the Centralised Container Management System. Formulated design problem questions guided the process to come to this design. Each of the problem design questions stated in the beginning of this report will be answered below to provide insight how the main design is being fulfilled.

**How should the LLP concept be interpreted from a theoretical perspective? (Chapter 2)**

The LLP concept can be described as a concept that provides logistics services to companies. It is defined to be a hybrid between an operational 3PL carrying the responsibilities of a 4PL. This results in the following set of LLP concept characteristics:

- Heavy asset based
- Total singular accountability (as if internal)
- Logistics, supply and demand chain integration
- Influences time and place utilities
- Maximise use of own assets in combination with third party equipment if needed
- Value creation within customer organisation
- Vertically and horizontally across the supply chain
- Execution of elements in the supply chain
- Own perspective (not neutral)
- Single point of contact

**What is IMLOG’s interpretation of the LLP concept which it provides for PRODA? (Chapter 3)**

IMLOG’s LLP concept for PRODA involves mainly containerised road and intermodal logistics services throughout Europe. Products being shipped are bulk liquid chemicals. Within the provided logistics services a distinction can be made between physical and administrative logistics services. Physical logistics services involve the physical activities related to road and intermodal transport, for example transportation and transhipment. Administrative logistics services involve for example coordination of the shipment orders between IMLOG and the LLP transport partners. The interface between PRODA and the LLP transport partner runs thru IMLOG, by which IMLOG provides a single point of contact for PRODA. This single point of contact can also be recognised in the payment structure: in general all flows run thru IMLOG. In this way IMLOG is besides providing logistics services by themselves also responsible for managing the LLP transport partners.

**To what extend does IMLOG fulfils the profile of a LLP according to literature? (Chapter 4)**

The quality level of IMLOG’s partnership with PRODA by the LLP concept is determined to be medium. Within this partnership the main focus is on operational elements of the relationship, where more attention is needed for relational elements in the partnership to be able to increase the quality. IMLOG’s LLP concept for PRODA fulfils fifty percent of the LLP concept critical success factors identified. Four critical success factors are not fully met, but with slight changes in the concept these factors could also be met in total. Only one critical success factors scores very low on IMLOG’s LLP concept for PRODA: IMLOG fulfils no leading role in logistics, supply and demand chain integration. With its LLP concept IMLOG was not able to neutralise all structural issues, also known as pitfalls,
identified in literature. No continuous improvement, no extensive performance measurement programme and a lack of pro-activity are the most important pitfalls encountered. On the other hand with its LLP concept IMLOG was able to completely avoid the pitfalls involving a lack of flexibility and tailored systems and structures and the absence of pan European coverage.

It can be concluded that IMLOG LLP concept for PRODA involves a partnership based on its elements, but in fact does not behave as an optimal functioning partnership. Based on the fulfilment on the LLP key success factors, IMLOG’s LLP concept cannot be classified as a full LLP from a theoretical perspective. Especially the low score on the “leading role in logistics, supply and demand chain integration and the medium score on “total singular accountability”, “value creation within the customer organisation”, “vertically and horizontally active across the supply chain” and “single point of contact” makes it impossible for IMLOG to be an full LLP on this moment.

The encountered pitfalls show as well that IMLOG was not able to neutralise current negative logistics business characteristics by operating its LLP concept for PRODA. This contributes heavily in the determination of IMLOG not acting as a full LLP for PRODA.

Nevertheless the analysis showed that IMLOG is on the right track in becoming a full LLP. The issues identified in the confrontation between practice and theory could serve as a start in a process where IMLOG becomes a full LLP.

**Which lessons can be learned from practice? (Chapter 5)**

Lessons can be learned from the issues identified in practice. A distinction can be made between three types of issues: relationship issues, service fulfilment issues and business process issue. The absence of extensive benchmark activities and a pro-active information supply by IMLOG are causing the majority of the relation issues identified. These issues concern mostly misunderstanding on each other’s position in the partnership. The number of underweight shipment and late deliveries are identified as service fulfilment issued. Business process issues identified involve mostly internal key processes within IMLOG’s LLP department, where a few are related to the interface with PRODA and the LLP transport partners.

The issues identified should be viewed as improvement opportunities through which IMLOG can improve its LLP concept for PRODA from a relationship, service fulfilment and business process perspective.

**Which factors influences the decision to elaborate on a certain identified improvement opportunity? (Chapter 6)**

Based on the issues identified, four main improvement opportunities are identified: business approach change, Customer Relation Management, performance measurement structure and business process change. Facilitation of growth, improvement of internal performance, creating a win-win situation and the challenge in the elaboration process are applied to select one of the main improvement opportunities. The business process change improvement opportunity is selected to elaborate upon. Within the business change improvement opportunity the container assignment process is selected as subject within the design task.

**Which fundamental change(s) should be made when adopting the designed improvement measure? (Chapter 9)**

The main fundamental change with the design of the integral container management system involves centralising all related container coordination activities in one single unit. This implies that container assignment, container management coordination and empty container repositioning activities fall no longer under the responsibilities responsibility of several regional based disposition departments. The Centralised Container Management System will take care of these three container management related functions in from an integral perspective.
What are important aspects when implementing the functional design of the chosen improvement opportunity? (Chapter 10)
Implementation of the design should lead to solving the issues encountered within the three container management functions: service levels and the efficiency of the process will improve. To reach this point, first the Centralised Container Management System must be implemented. Therefore insight is provided in the resources needed for and the costs involved with the implementation of the Centralised Container Management System. Additionally, process change management is identified as an important aspect in successful implementation of the design. Another important aspect related to the implementation to the Centralised Container Management System is the level of automation applied in the three container management processes. Therefore a first insight is provided in automation of container management functions by a Decision Support System. Additionally further steps in the development process towards a full operational CCMS are proposed.
Numerous recommendations in this project can be made, although one is more interesting than the other. A distinction is made between recommendations related to the first two parts of the report and the last part. First the recommendations on the issues and opportunities identification including the selection are presented, followed by recommendations related to the functional design made.

**Recommendations**

**Issues & opportunities identification & selection**

**Attitude change is essential in improving IMLOG LLP concept.**
For a recommendation to be helpful, IMLOG must will to change its current way of working. Without the support in the company to change, each recommendation’s intention cannot be fulfilled.

**The customer must be more involved in the issue identification process.**
This report identified issues concerning IMLOG’s LLP concept mainly by comparing literature with practice and investigating practices on itself. The interviews conducted with chemical producing companies showed that more issues can be identified by further involvement of the (potential) customers of a LLP concept. By adopting this approach IMLOG should be able to tailor it logistics services in a better way to the need of the customer. This will lead in time that the LLP concept is continuously being improved.

**Structured approach in relationship management is needed.**
The concept and relationship issues led to the identification of Customer Relationship Management (CRM) to solve those issues. Due to restrictions in the project this improvement opportunity could not be elaborated, although it is of major importance when improving IMLOG’s LLP concept. Adopting a CRM strategy involves a structured approach in managing the relationship between IMLOG and its customer. Eventually it should lead to higher customer satisfaction which will have a positive effect on the success of the LLP concept perceived by the customer. On the long run this means that the customer could decide positively to proceed with the LLP concept.

**An extensive performance measurement programme is needed.**
Among the issues identified in this project absence of an extensive performance measurement programme can be identified as a common denominator. Due to the absence of an extensive performance measurement programme it is hard to measure improvements of the LLP concept after measures have been implemented. Therefore the performance measurement should not only focus on the service delivered to the customer, but also on the internal performance of IMLOG. Additionally this extensive performance measurement programme should cover the “soft” aspects of the LLP concept, like the quality of the partnership, as well. Having an extensive performance measurement programme will contribute in a positive way to the relationship concerning the LLP concept.

**To take more advantage of automation, IMLOG’s information system must be improved.**
The information system fulfils a key supporting function within the LLP concept: it responsible for the storage of all information related to the logistics service provided. Currently the system is designed for current use and therefore hardly any process optimisation by automation is possible. Improving the functionalities within IMLOG’s information system enables processes to be automated through which current processes within the LLP concept can be optimised. Improving the functionalities within IMLOG’s LLP concept will enable the use of an extensive performance measurement programme. Finally, using the full potential of IMLOG’s information system for automation will contribute to the improvement of the LLP concept.
Focus on internal business process improvement.
This report showed that IMLOG’s LLP concept can be improved in several ways. In line with the decision to elaborate on the container management process it important first to focus on internal business process improvement opportunities. By taking advantage of these opportunities, not only IMLOG benefits, but the customer indirectly as well through the service provided by the LLP concept. The next step after internal business processes are optimised could involve further integration with the customer by adding services to the LLP concept.

Design
The presented functional design can be seen as one of the first steps in the development process towards the implementation of an integrated container management system. The design provides insight on the system’s design, structure, processes and procedures from a high level perspective. Lots of steps have to be taken before the proposed system can be implemented. For this the development steps mentioned in paragraph 10.5 should serve as guideline. Following these steps will lead to more knowledge and understanding of the CCMS. The steps provided in paragraph 10.5 show that there are two main feasibility checks incorporated in the development process. This gives IMLOG the opportunity to abandon the project in a later stadium of the project as more information, on for instance costs, becomes available.
Following recommendations will relate to further steps in the development process towards the implementation of the CCMS.

A broad scope in the development process must be adopted.
Before the functional design of the Centralised Container Management System (CCMS) can be implemented, lots of steps have to be made. The design of the CCMS must be elaborated in detail: procedures have to be formulated, interfaces have to be specified, equipment specifications have to be drawn up, an implantation plan have to be constructed et cetera. Within these activities a broad scope must be adopted. Adoption of a broad scope in the development process will for instance lead to the identification of the effects of implantation of the CCMS on IMLOG’s organisational structure. Another point of interest could be the quantity mentioned in the shipment order. If the amount of product ordered could alternate between a minimum and a maximum will make the assignment of suitable containers a lot easier. The specific quantity to be loaded will be determined by IMLOG depending on the containers available. Adopting this broader scope approach enables the CCMS to be tailored to the environment it will function in, which should eventually lead to an optimal use of the CCMS’s potential.

A high level of automation should be adopted to realise long term efficiency improvements.
As shown before, automation could play an important role within the CCMS. Taking advantage of the automation allows IMLOG to improve the efficiency of container management related processes enormously. Automation can be applied in the processes related to the three container management functions by the application of a Decision Support System (DSS). Increasing the level of automation within container management requires for instance more functionalities of IMLOG’s information system. This kind of dependencies must be identified before a high level of automation can be applied.

Change management must have a high priority in further development.
Designing the CCMS is on step towards implementation, but a bigger challenge may be found in changing the organisation towards the arrival of the CCMS. Therefore a focus must be on managing the changes involved with the implementation of the CCMS. For instance, support for the CCMS has to be created for a successful implementation and operation.
A focus must be on data in further development steps.
The proposed functional design for integrated container management depends heavily on data, especially when a high level of automation will be applied. Without having the right information available, the container management process cannot properly be executed. Therefore, a focus in further development should be on gathering and structuring the appropriate, correct data on which the container management processes rely.

Include multiple shipment orders assignment per container per day in the CCMS.
As mentioned in paragraph 9.5, the presented functional design suits best for long-distance transport: assigned containers can only be loaded once a day. In case of short-distance (road) transport, containers should be loaded multiple times a day to optimise the container occupancy rate. It makes no sense to use two different containers for two different shipment orders to be loaded on the same day. If the circumstances allow it, one container should be used for both shipments. The other container can be used for another shipment order.

Investigate the incorporation of real-time container assignment in the CCMS.
Currently, containers are assigned to shipment orders the day before shipment orders must be loaded. Shortening the period between the assignment of the container to a certain shipment order and the loading could lead to more efficient use of containers. In this case, a container should be assigned on the moment the container is picked up several hours before loading. This allows to clean the container if necessary, drive to the loading location or perform other activities. Adopting this approach prevents containers not being used for a certain time period before loading which eventually lead to an increase in the container occupancy rate.

Investigate the potential of integrating transport planning and the CCMS with help of automation.
Currently, none of the transport planning and container management processes are automated. The presented functional design allows automation of the major part of the container management processes. Container management and the transport planning processes are closely related: the transport planning process depends on the results from the container management processes. Further investigations should be made on how these two disciplines can be further integrated to improve the efficiency of container usage. Automation should play an important role in this process as it plays a major role within the container management processes.
The following reflection will elaborate on the Master graduation project where this report is a result of. It will provide insight in the authors experience and opinion on different aspects of the project. First the theory encountered in the project is discussed, followed by the experience gained from practice. The reflection concludes in the author’s experience on performing a Master graduation project at IMLOG AG.

Theory
Extensive literature research showed that there are multiple definitions of a LLP, but they are all slightly different. This makes it hard to determine an exact understanding on the LLP concept. The same counts for other logistics concept like for example 3PL and 4PL: definitions exist but cannot exactly reflect what those concepts imply. This implies that no pure form of those described concept can exist in reality, although different kinds of logistics concepts are stated in literature. A lot of different type of hybrid forms exists between the pure logistics concepts, where the LLP concept is an example. This concept can be identified as a hybrid between an operational 3PL with the responsibilities of a 4PL, as mentioned earlier in the report. Exactly which services are provided by a logistics concept is not definite and depends from LSP to LSP and the needs from the market. This shows that logistics is still a customer pulled business and most of the logistics concepts originate from the customer side.

Due to the shallowness on the form and content of the LLP concept it is hard to determine whether a distinction must be made between a general LLP and a more specialised LLP. General LLPs provide every kind of logistics services related to each type of product thinkable. IMLOG is an example of a specialised LLP providing only logistics services involving liquid bulk chemical products with a main focus on intermodal transport. When a company decides to specialise itself in a single logistics activity it can be recognised as specialised LLP. Can this kind of companies being identified as a LLP? What are the minimum requirements on the capabilities of a LLP? These kinds of questions should be answered in obtaining a clear understanding on the LLP concept.

In the author’s opinion the LLP concept does not distinguish itself on a high level as a totally new kind of logistics service concept. The LLP concept emerged when LSPs (3PLs) wanted to provide 4PL services, without being a 4PL in real life. Because these LSPs cannot be classified as 4PLs, but a need to distinguish themselves from “regular” 3PLs, the name “Lead Logistics Provider” was introduced. From a marketing perspective this is a good approach to show as LSP that you can do more (better) compared to a 3PL with maintaining the quality of the services delivered by using own resources as a 3PL. Such a LSP shows the customer that it can create a win-win situation for the customer by taking more advantage of the services provided by the LSP with the reliability and good experience of working with a 3PL. It is just how you name the concept.

As is the case with other logistics concept, the form and content of the LLP concept can differ from situation to situation. The reason can be found in the fact that the LLP concept inherited its characteristics from the 3PL and 4PL concept which are both not having a definite form and content. Is it therefore interesting to adopt the term LLP in literature when discussing logistics concepts? According the author this is not necessary: in fact a LLP remains a 3PL providing additional 4PL services and not the other way around. More interesting should be the identification of different kinds of 3PL concepts offering additional services like the LLP concept. This enables to obtain a better understanding on the LLP concept and to position it between other variances of 3PL.

Practice
Besides the theoretical part, the project knew as well a major practical part. An efficient way to get to understand IMLOG’s LLP concept is by “experiencing” the project on a daily basis. This approach led to a position for three months within IMLOG’s LLP department for PRODA.
By being responsible for the LLP transport partner coordination knowledge on not only general, but also unique aspects of IMLOG’s LLP concept is obtained. Especially understanding the operational complexity within IMLOG’s LLP concept took a few weeks. Also IMLOG’s dependencies in the logistic business are bigger than have been expected up front. Those dependencies are often hard to explain to customers resulting in a lot of misunderstanding between both parties. This shows as well IMLOG’s position as an LSP that delivers a commodity service, where customer is perceived to be king.

Experience at IMLOG’s LLP department showed as well the importance of proper and standardised communication. Lots of problems, inefficiencies and misunderstandings can be prevented by informing each other in time and correctly. Therefore information sharing is crucial when operating logistics as efficient as possible.

IMLOG manual approach in planning of shipment order by use of magnets is often perceived as outdated and conservative. A few weeks working with this approach shows the practical value of such a system. First of all shipment orders and containers are not virtual and therefore easier to handle in the planning and execution process. Second, due the complexity and interdependencies in IMLOG’s project it will be hard to automate every single process. Third, all main information of the container and shipment order is written on the magnet so information is quickly available. Fourth, by visualising shipment orders and containers by use of magnets enable to create a general overview of the planning in a short time period. These arguments together show that this approach suits perfectly the manual operated disposition processes. Continuing the application of this approach when improving the efficiency of the total system by automation will probably result in problems in the future.

Practice showed as well that there is still a big gap between theory and practice within the logistics business. Theoretical frameworks and models do not deliver the projected success resulting in the application of old, reliable methods and process innovation remains on a low level. Also complexity and dependencies within the logistics business is not fully recognised which contributes to the mismatch between theory and practice. Especially this complexity and these dependencies should be more a topic of interest in research instead of simplifying the reality in theory.

Graduation process

The graduation project can be classified as an experience thru which skills and knowledge is gained. Being solely responsible for a project was something new. This implied that all kind of aspects has to be managed in an integrated way. First there is IMLOG, offering a position within their company to conduct a project including their needs and wishes on the content of the project. Second, the university has a stake in the determination of the project’s content well. The needs and expectations of these two actors have to be managed, which was sometimes a bit challenging. In respect to IMLOG and the university the scope of the project has to be determined, which took more time and energy than expected up front. By being responsible for managing the needs and expectations of IMLOG and the university in combination with the scope determination the project becomes something of your own. This is in contrast with a situation where the scope and the procedure to deliver a result are predetermined.

First thought at the beginning of the project was to improve IMLOG’s LLP in total through identification of all kind of issues, developing measures which should solve each measure and if possible implementing these measures. In time experience showed that no crucial issues existed within IMLOG’s LLP concept for PRODA that should led to a termination on short notice of the partnership between both parties. Of course small adjustment could be made to improve the efficiency of the current processes. Radical improvement could only be achieved by changing processes, approach and structure of IMLOG’s LLP concept fundamentally. Therefore changes for radical improvement involve more complex measures compared with adjustment of current processes. Due to (mainly time) restrictions, not all issues/improvement opportunities could be elaborated. It took some time to realise that it was simply not possible anymore to improve IMLOG’s LLP concept in total but only for a small part. Although not all improvement opportunities are
elaborated, the decision to elaborate on the central container management functionality was in the author’s opinion a logical one. Also the identification on other issues and improvement opportunities prove to be valuable in improving other aspects of IMLOG’s LLP concept.

Project execution at IMLOG

Conducting a Master graduation project for a company like IMLOG is a true opportunity to gain experience and understanding of logistics business in real life. Especially the combination of the pioneering character of the assignment and being a part in IMLOG’s LLP concept appealed very much to me. Due to pioneering character of the LLP concept an extensive literature study was needed to gain a better understanding on logistics service concepts from a theoretical perspective. Combining this knowledge with practice was a challenge, but resulted in satisfaction at the end of the project. The satisfaction also resulted from the fact that not solely a theoretical solution is delivered, but a solution that is tailored to the reality with all its complexity.

Working within IMLOG’s LLP department was according the author’s opinion probably the best approach to get a full and thoroughly understanding on the concept IMLOG provides for PRODA. Another plus point of working internally understanding on involves the opportunity to experience other (business) cultures by working within an international oriented team, conducting business throughout entire Europe. IMLOG’s LLP department knows German as official language, which provided the opportunity to improve the German language as well. Also the colleagues were really pleasant to work with. They provided a lot of tacit information and were always open for discussions about certain project related topics.

Besides logistics services involving liquid bulk (as is the case with IMLOG’s LLP concept for PRODA), IMLOG provides logistics services for dry bulk as well. During the working period the author had the opportunity to get to know this business as well by working at this department of the IMLOG company. One of the nicest experiences involved being a co-driver on one of IMLOG’s trucks, both liquid and dry bulk. This experience provided so much valuable insight in the activities that are involved with the physical logistics activities; it makes understanding the logistics business much easier.

Next to the above mentioned plus points, several improvement opportunities can be mentioned as well. These improvement opportunities result from a mismatch between the author’s expectations on the project and how these expectations are met in practice. These points could prove to be valuable when supervising other students in their graduation work. The same lack of pro-activity in the logistics business can also be found in the supervision of the project. First of all a clear strategy of IMLOG concerning this project was not fully available. The reticence from IMLOG’s side resulted in discussions not going much in depth on the project’s content. It would have been nice to determine the strategy together, where both parties treat each other as equals instead of one being the customer and the other the supplier. This is exactly how IMLOG does not want to be treated by customers in a partnership, but have been acting as such in this project. For certain information IMLOG acted quit reserved: information estimated to be valuable in the project was not supplied. This made it sometimes hard to go into detail on certain topics without having proper information.
Epilogue

Looking back, conducting a Master thesis project for IMLOG was the perfect opportunity for me to conclude the Master programme Transport Infrastructure & Logistics. Especially the combination between theory and practice within the project was perfect. Combining both was sometimes a bit of a challenge but I experienced it positively: I was able to develop my knowledge on logistics and skills.

Conducting the Master graduation project resulting in this project would not have been possible without the cooperation of the following persons:

- Prof. Dr. Ir. A. Verbraeck  Delft University of Technology, Faculty TPM section System Engineering
- Ir. M.W. Ludema  Delft University of Technology, Faculty TBM section TPLO
- Dr. Ir. J.A. Ottjes  Delft University of Technology, Faculty 3ME section TEL
- A  IMLOG, Project department
- B  IMLOG, Project department
- C  IMLOG, LLP department
- D  IMLOG, LLP department
- A  IMLOG, LLP department
- F  IMLOG, LLP department
- G  IMLOG, LLP department
- H  IMLOG, LLP department
- I  PRODA

Hereby I would like to thank these persons for the time and effort they spend on supporting me in conducting this Master graduation project.
Bibliography


APPENDICES
Appendix A – PRODA operational characteristics

Geographical orientation
IMLOG’s LLP concept for PRODA takes liquid bulk chemical transport into account to customers in mainly Europe. Different types of loading locations are considered in the LLP concept. First type loading locations are the plants of PRODA where products are being produced. Second type of loading locations is a third party storage location. These third party storages locations are supplied by overseas production locations by ship. Last type loading locations are supply locations: these are locations where products are produced for PRODA by third parties. Table A contains the loading locations dealt with in IMLOG’s LLP concept for PRODA.

<table>
<thead>
<tr>
<th>Production location</th>
<th>Storage location</th>
<th>Supply location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

Products
IMLOG’s LLP concept handles the outbound logistics for the liquid bulk chemicals of PRODA in Europe. Without getting too much in detail on the different types of chemical products handled by the LLP concept, a list of the most important product groups are given below:

- A
- B
- C
- D
- E
- F
- G
- H
- I
- J
- K
- L
- M

Dedicated and non-dedicated load units
Because IMLOG’s LLP concept only handles liquid bulk shipment, tank type load units are used for shipping goods from the loading location to the final destination. Combining this fact with IMLOG’s focus on intermodal transport a tank container is the most applicable load unit to use when shipping bulk liquid chemicals with this LLP concept. Within the LLP concept for PRODA a distinction is made between dedicated and non dedicated tank containers. The usage of dedicated container for a specific chemical product depends on the characteristics of the product. For instance dedicated containers are used for products used in the food industry: contamination of the product could lead to gigantic health problems. On request of PRODA dedicated containers are use for specific products. Although these dedicated containers are sent back to the loading station empty, these containers no not have to be cleaned in most cases. Table B presents the type of product that requires the use of dedicated container, including the owners of these containers. On request from PRODA several of its clients require the ordered product to be delivered by dedicated tank containers as well.
Table B - Products with dedicated containers including owner

<table>
<thead>
<tr>
<th>Product</th>
<th>Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>IMLOG</td>
</tr>
<tr>
<td>B</td>
<td>IMLOG</td>
</tr>
<tr>
<td>C</td>
<td>IMLOG</td>
</tr>
<tr>
<td>D</td>
<td>A</td>
</tr>
<tr>
<td>E</td>
<td>A</td>
</tr>
</tbody>
</table>

Non-dedicated tank containers are used as well to ship the liquid bulk chemicals. These tank containers are allowed to contain different types of products. This has a positive effect on the occupancy rate of container, because it decreases the times that a container is shipped empty. Re-loading of the non-dedicated container is applied when the previous shipped product is the same as the product to be loaded. Another general perquisite is that this container will be loaded within seven days from the delivery of the previous load. When the previous loaded product corresponds with the product to be loaded, the container has to be cleaned. The certificate obtained by cleaning the tank container is valid for 48 hours.

Besides tank containers tank trailers are used as well in the road transport, not in the intermodal transport. These tank trailers are in general non-dedicated and have to be cleaned with each new shipment when re-loading cannot be applied.

LLP transport partners

Table C - LLP transport partners

<table>
<thead>
<tr>
<th>LLP transport partner</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>2</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
</tr>
<tr>
<td>E</td>
<td>5</td>
</tr>
<tr>
<td>F</td>
<td>6</td>
</tr>
</tbody>
</table>
Appendix B – IMLOG: a leading LSP in chemical logistics

Logistics services
The services IMLOG provides for its customers can be classified into three types, which can be recognised in the three major functions of the LLP concept as well (see paragraph 4.2). IMLOG’s core function is the provision of physical transport services including all physical activities that are related to this transport. These physical transport services and the related physical support activities together will be named physical logistics services. Other types of logistics services provided by IMLOG have an administrative function, which are known as administrative logistics services. A customer of IMLOG can decide to perform these administrative logistics by themselves or to outsource it to IMLOG. The administrative logistics services should not be confused with IMLOG’s internal administrative activities related to the three different types of services provided to the customer. The last type of services IMLOG provides are logistics integration services, which are in fact a one or more physical logistics and administrative logistics services combined. Table D shows which services are offered by IMLOG per logistics service type.

<table>
<thead>
<tr>
<th>Physical logistics services</th>
<th>Administrative logistics services</th>
<th>Logistics integration services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation</td>
<td>Order management</td>
<td>Pre-loading concept</td>
</tr>
<tr>
<td>Transhipment</td>
<td>Document handling</td>
<td>Production logistics concept</td>
</tr>
<tr>
<td>Storage</td>
<td>Customs documents</td>
<td>Hub concept</td>
</tr>
<tr>
<td>Driver loading</td>
<td>Transport planning</td>
<td></td>
</tr>
<tr>
<td>Product heating</td>
<td>Loading station planning</td>
<td></td>
</tr>
<tr>
<td>Weighing</td>
<td>LSP coordination</td>
<td></td>
</tr>
<tr>
<td>Container cleaning</td>
<td>LSP payment</td>
<td></td>
</tr>
<tr>
<td>Repacking</td>
<td>Inventory management</td>
<td></td>
</tr>
</tbody>
</table>

Most of the physical and administrative logistics services mentioned in the table above should be clear, but a few deserve some extra attention. With the “driver loading” service the truck driver is responsible for loading process without any assistance of the loading location’s personnel. Depending mostly on customer wishes and the product temperature during loading the product has to be heated or not before delivering to the client. If heating is necessary the “product heating” service will be applied. With “repacking service” is meant that IMLOG takes care of moving the product itself from one load unit into another one.

As written before the logistics integration services are combined physical logistics and administrative logistics services. To gain a better understanding on the different logistics integration services, the first three concepts mentioned in table D will be elaborated below.

Pre-loading concept
The pre-loading concept decouples the loading activity and the following transport activity, see intermodal and road transport activity chains in paragraph 4.2. After the container is loaded it will be stored on a terminal before it will be shipped to the delivery location by road or intermodal transport. When applying the pre-loading concept the product availability at the loading station is the leading factor in the loading planning instead of the availability of the truck. In practice this pre-loading concept is already applied with intermodal shipments. The only difference with the situation without a structural pre-loading concept is that the availability of the truck is the leading factor in the loading planning.

Production logistics concept
The production concept takes care of the inbound and/or the outbound logistics of a production plant. With this concept the production process is directly fed with raw materials from the inbound
container and the produced product is directly stored in an outbound container. By organising inbound and outbound logistics in this way the production plant does not need (intermediate) storage space for inbound and outbound flows.

**Hub concept**

The hub concept involves strategic positioning of inventory throughout a geographical area. The goal of this concept is to improve the logistics service quality by shortening the shipping lead time from the moment an order is placed. After the load units are loaded they are sent to the terminals in close proximity of the final delivery location. This concept can be recognised as a push strategy in the supply chain.

A customer can decide to use a single logistics service of IMLOG or service package consisting of more than one logistics service. The LLP concept is such kind of a special logistics service package to stimulate logistics integration among LSPs and producing companies. Therefore it could be identified as a logistics integration service, but it involves more than that. Within a LLP concept logistics integration services as mentioned can be included within the LLP concept besides physical logistics and administrative logistics services. This is not possible within a pre-loading, production logistics and hub concept.

**Resources**

For providing its three different kinds of services IMLOG used resources, where a distinction can be made between the resources used for each kind of service. Table E states the resources used for physical logistics services and for administrative logistics services. Due to the fact that the logistics integration services are a combination between physical and administrative logistics services, its resources are not specifically mentioned in table E.

<table>
<thead>
<tr>
<th>Physical logistics services</th>
<th>Administrative logistics services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road trucks</td>
<td>Information system</td>
</tr>
<tr>
<td>Terminals</td>
<td>Relationships network</td>
</tr>
<tr>
<td>Load units</td>
<td>Communication equipment</td>
</tr>
<tr>
<td>Heating equipment</td>
<td>Facilities</td>
</tr>
<tr>
<td>Cleaning equipment</td>
<td>Knowledge</td>
</tr>
<tr>
<td>Weighing equipment</td>
<td>Employees</td>
</tr>
<tr>
<td>Repacking installation</td>
<td></td>
</tr>
<tr>
<td>Employees</td>
<td></td>
</tr>
</tbody>
</table>
Appendix C – Shipment order profile

- Executing LSP
- Loading location
- Loading date
- Loading time
- Delivery date
- Delivery time
- Delivery location
- Product
- Quantity
- Route
- Mode(s) used
- Load unit
Appendix D – Scoring KPIs in detail

VIR – Vendor Improvement Request
- Objective: 0
- Maximum score: A out of 100 points
- \( \text{VIR score} = 35 - \left( \frac{\text{# of VIRs}}{\text{# of shipments}} \times 15000 \right) \)

SIR – Service Improvement Request
- Objective: X percent of the total number of shipments
- Maximum score B out of 100 points

QIR – Quality Improvement Request
- Objective: Y percent of the total number of shipments
- Maximum score C out of 100 points

Responsiveness on VIR/SIR/QIR
- Objective: VIR in F days, SIR in G days, QIR in H days
- Maximum score: D out of 100 points

Underweight shipments
- Objective: 0
- Maximum score: E out of 100 points
- Condition: underweight discrepancy is bigger than I%
- Cause of the underweight is the incorrect assignment of a container
## Appendix E – Distribution of shipments between LLP transport partners

### Table F - Distribution of shipments between LLP transport partners based on loading location and product type

<table>
<thead>
<tr>
<th>LSP</th>
<th>Loading location</th>
<th>Destination</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td>x x x x x x x x x x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>x x x x x x x x x x x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>x x x x x x x x x x x</td>
</tr>
<tr>
<td>B</td>
<td>x</td>
<td>x x x x x x x</td>
</tr>
<tr>
<td>C</td>
<td>x</td>
<td>x x x x</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td>x x x x x</td>
</tr>
<tr>
<td>E</td>
<td>x</td>
<td>x x x x x x x</td>
</tr>
<tr>
<td>F</td>
<td></td>
<td>x x x x x x x</td>
</tr>
</tbody>
</table>

IMO:

| G   | x x x x x x x x x x x x x x x |
|     | x x x x x x x x x x x x x x x |
|     | x x x x x x x x x x x x x x x |
|     | x x x x x x x x x x x x x x x |
Appendix F – Shipment distribution algorithm

Figure G - Decision tree related to the distribution of shipments between the LSPs involved
## Appendix G – Partnership quality determination

Table G - Partnership quality description according method of Lambert, Emmelhainz, & Gardner (1996)

<table>
<thead>
<tr>
<th>Partnership component</th>
<th>Score level</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Planning</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Style</td>
<td>High</td>
<td>Systematic: both scheduled and ad hoc</td>
</tr>
<tr>
<td>Level</td>
<td>Low</td>
<td>Focus on projects or tasks</td>
</tr>
<tr>
<td>Content</td>
<td></td>
<td>Performed jointly, eliminating conflicts in strategies (medium)</td>
</tr>
<tr>
<td><strong>Joint operating control</strong></td>
<td>Medium</td>
<td>Measures are jointly developed and shared; focus on individual firm’s performance</td>
</tr>
<tr>
<td>Ability to make changes</td>
<td>Low</td>
<td>Parties may suggest changes to other’s system</td>
</tr>
<tr>
<td><strong>Communications</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-routine</td>
<td>Medium</td>
<td>Conducted more regularly, done at multiple levels; general open and honest</td>
</tr>
<tr>
<td><strong>Organisational</strong></td>
<td>High</td>
<td>Systematised method of communication; may be manual or electronic; communication systems are linked</td>
</tr>
<tr>
<td>Balance</td>
<td>Medium</td>
<td>Two-way but unbalanced</td>
</tr>
<tr>
<td>Electronic</td>
<td>Medium</td>
<td>Joint modification of individual system</td>
</tr>
<tr>
<td><strong>Risk/reward sharing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss tolerance</td>
<td>Medium</td>
<td>Some tolerance for short-term loss</td>
</tr>
<tr>
<td>Gain commitment</td>
<td>Low</td>
<td>Limited willingness to help the other gain</td>
</tr>
<tr>
<td>Commitment to fairness</td>
<td>Low</td>
<td>Fairness is evaluated by transaction</td>
</tr>
<tr>
<td><strong>Trust and commitment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trust</td>
<td>Low</td>
<td>Trust is limited to belief that each partner will perform honestly and ethically</td>
</tr>
<tr>
<td>Commitment to each other’s success</td>
<td>Medium</td>
<td>Commitment is to a longer term relationship</td>
</tr>
<tr>
<td><strong>Contract style</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timeframe</td>
<td>Medium</td>
<td>Covers a longer time frame</td>
</tr>
<tr>
<td>Coverage</td>
<td>Low</td>
<td>Contracts are specific in nature</td>
</tr>
<tr>
<td><strong>Scope</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share</td>
<td>High</td>
<td>Activity covered by relationship represents significant business to both parties</td>
</tr>
<tr>
<td>Value-added</td>
<td>Low</td>
<td>Relationship covers only one or a few value-added steps (functions)</td>
</tr>
<tr>
<td>Critical activities</td>
<td>High</td>
<td>Activities that are critical for each partner’s success are included</td>
</tr>
<tr>
<td><strong>Investment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial</td>
<td>High</td>
<td>High value assets may be jointly owned</td>
</tr>
<tr>
<td>Technology</td>
<td>Medium</td>
<td>There is some joint design effort and there may be some joint R&amp;D planning</td>
</tr>
<tr>
<td>People</td>
<td>Low</td>
<td>Limited personnel exchange</td>
</tr>
</tbody>
</table>
Appendix H – Framework for CRM strategy

Figure H - A conceptual framework for CRM strategy (Payne & Frow, 2005)
An important decision in the container assignment algorithm involves the match between certain shipment order’s fixed attributes and fixed attributes related to the container. The decision whether there is a match based on these attributes involves attribute checks on:

- **Dedicated equipment class**: In certain cases special dedicated containers are used for a specific customer-product combination. Therefore dedicated equipment should be assigned when mentioned in the order.
- **Required container class**: Depending on the type of transport, the product to be transported et cetera a certain container class is needed. For instance maritime transport requires other type of containers then road transport.
- **Load volume**: This check provides a definite answer whether the container is able to load the volume requested in the shipment order. Due to safety reasons not every container is allowed to contain less or more than certain percentage of its technical capacity. For that the minimum and maximum volume a container can contain will be used.

Figure J displays the decision tree related to the check whether there is a match between the fixed attributes of the shipment order and the container.

In case no container can be assigned to the shipment order, the entire process starts from the beginning until a successful match is made. In the case no suitable container is found at the end of the day, the customer must be informed so necessary measures can be taken.
Appendix J – Planning empty container repositioning

When looking at container planning, where empty container repositioning can be ascribed to, according Shen & Khoong (1995) three different levels can be distinguished, see figure K. The lowest level is the terminal planning, which involves the movements of containers on the terminal itself, but incoming and outgoing containers as well. One or more terminals together form a region where in this region the planning involves the terminals in this specific area: the intra-regional planning. For instance IMLOG has in area X an own terminal, but uses terminals of third parties as well. The intra-regional planning decides which containers from what terminal are used for loading a shipment order. The inter-regional planning focuses on the planning of the containers between regions, which is exactly the planning level where repositioning of empty containers is involved with. Repositioning of empty containers within a region is perceived not to be cost effective due to the relative high costs involved with shipping an empty container in the same region. Most of the time terminals in a certain region lay in relatively close proximity from each other, so it does not matter a lot from which terminal the container will be pick up for loading.

Figure K – Planning levels in empty container repositioning (Shen & Khoong, 1995)