

MASTER

The conceptual design of a chemicals distribution optimisation tool

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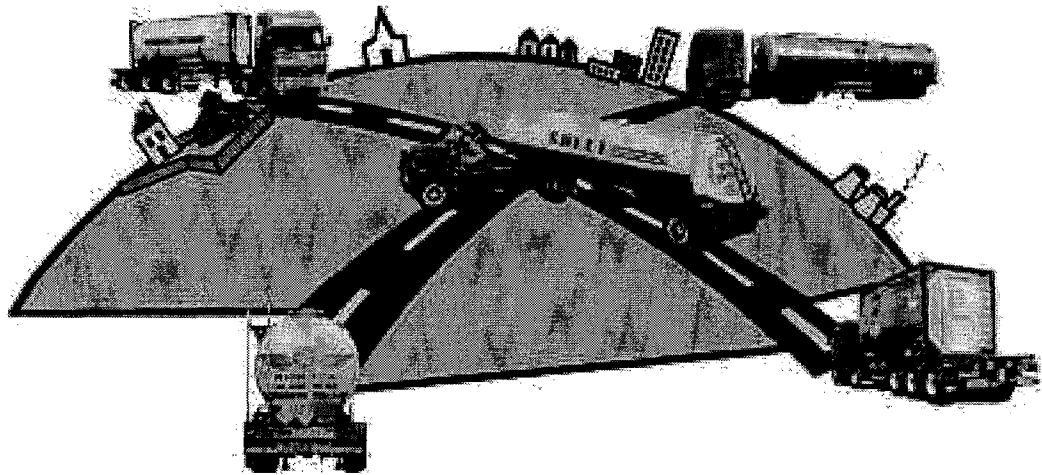
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“ The Conceptual design of a Chemicals Distribution Optimisation Tool”



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UITLEENBAAR**

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Abstract

The final research project partly described in this (public) report is conducted for a large chemical producer of bulk chemicals (Company X). The research concerns the evaluated conceptual design of a Chemicals Distribution Optimisation Tool (C Dot). The name C Dot is used for the conceptual design, which will be the result of the research project.

Ch. 1 Introduction and definition of the research project

The first chapter will define the research project. After an introduction to the project (§1.1), the restrictions defining the scope of the research project will be given (§1.2). Paragraph §1.3 will define the project goal and the deliverables and paragraph 1.4 presents the research model.

§1.1 Introduction of the project

Chemical producer X aims to improve the management of transportation costs. The company is currently paying for the inefficiencies of the Chemical Transport System. Empty driven kilometres are calculated in transport tariffs and cleaning decisions are not always made in the most cost efficient way. The non-optimal usage of vehicles is an important inefficiency and, influenced by congestion, resolution will become even more urgent. Transportation costs will come under increasingly more pressure due to increasing diesel prices and environmental taxes. Hauliers do not show enough high-impact improvement initiative and therefore chemical producer X itself is evaluating the option to initiate an optimisation initiative in the form of an industry-wide system (here defined as the C Dot¹). The reasons for the chemical producer asking for this research project are:

1. Improved management of transportation costs
2. The tackling of the existing industry inefficiencies
3. The expected light shift from a buyers market to a sellers market (chemical transport market)
4. New possibilities arising from e-business
5. Lack of initiative from the Logistics Service Providers (LSP's)
6. Entrepreneurial opportunity for X
7. Shift to intermodal transport
8. Contribution to X's image of sustainable development
9. Stimulation of innovation potential in Chemical transportation

§1.2 Initial scope of the research project

The six initial restrictions to the scope of the project are defined here. If further progress will call for more restrictions to the scope of the research project, these will be explicitly mentioned.

1. The research project will focus on road bulk transport. Road bulk transport is done by tank trucks consisting of a separate truck and trailer. Intermodal transport will only be taken in account if identified as a valid alternative to road transport. Intermodal is still in a preliminary phase in chemical transportation. Benefits of the C DOT will first become clear in road transportation but the system should be flexible enough to optimise intermodal transportation in the future.
2. The geographical focus will be on Europe. The relevant office of chemical producer X coordinates the orders for both Europe and Africa. Africa will not be considered because the number of orders is relatively small and transportation is mainly done over sea.
3. The products covered are the chemical liquids. These products have various characteristics and this results in different requirements for the transportation. These requirements refer to the conditions in which the products should be transported (e.g. temperature, pressure) and the special equipment that should be carried (e.g. pumps, cooling).
4. Only full truckloads will be considered. Only a minority percentage of X's orders consist of less-than-full truckloads (25%). X is very actively trying to decrease the number of orders not covering

¹ Chemicals Distribution Optimisation Tool (C DOT) will be the working name until a better suitable name will be developed or until the further use of this name is justified.

a full truckload. Full truckloads also refer to truckloads being separated by several compartments but together constituting a full truckload.

5. The transport activities in the logistics streams that will be covered in this project are dominated by road transport. The logistics primitive form of X's distribution² organisation is shown in the following figure. A distinction is made between direct delivery and indirect delivery. Direct delivery refers to product movements from a production site to the customer. Indirect delivery refers to product movements from a production site to the customer via a depot of X nearby the customer's site. The transportation activities, marked blue in the figure are dominated by road transport and define the focus of this project. The Customer Order De-coupling Point (CODP) is the point to which the customer order penetrates the Supply Chain of X. The CODP in both direct and indirect delivery is shown in figure 1.1 as well.

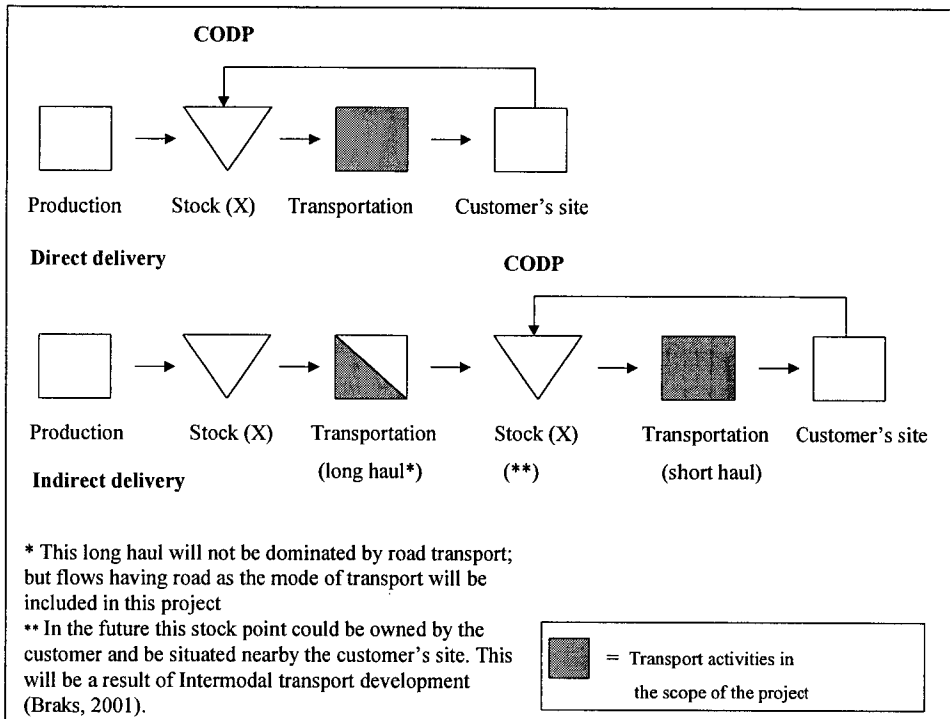


Figure 1.1: Transport activities in the scope of the project

6. This research project is done in parallel with other internal improvement projects. Examples of these projects include Supply Chain optimisation, VMI (Vendor Managed Inventory), implementation SAP R/3, unpredictable customer behaviour and cost-to-serve profitability of different customer segments. Supply chain optimisation is a very important project and is looking at the following issues: product availability, loading place optimisation, the quality of the product, the geographical spread of product locations, depots and customers, and demand variability. The issues covered by these other projects will not be in the (prime) scope of this research project; although connections between these mentioned projects and this research project can be identified. Developments in one area can even strengthen the development in another area, e.g. intensified VMI application could possibly stimulate the development and the acceptance of a C Dot.

² Distribution is used within X as well as within the largest part of the chemical industry to refer to transportation and distribution. Chemical hauliers execute both transportation and distribution. At this stage of C Dot development no distinction is made between transportation and distribution. Van Donselaar and Sharman used the term distribution in the BRAVO project to refer to the set of trips, which satisfy one of the following criteria: 1) the loading plus unloading time is longer than the driving time. 2) the distance between the first and the last stop of a trip is larger than 50 per cent of the total distance per trip. The remaining set of trips were categorised as "transportation". [Donselaar and Sharman, 1997]

§1.3 Goal and deliverables of research project

Based on the problem discussion and the project scope, the following research goal is defined:

Delivering an evaluated conceptual design of a Chemicals Distribution Optimisation Tool, addressing the principal Chemicals Distribution inefficiencies and matching the requirements of X.

Explore the critical conditions³ under which this tool will be beneficial and define the necessary changes to the current chemical transportation market.

§1.4 Research model

The main phases of this project research model are modelled on the linear model of New Product Development [Trott, 1998] and on the innovation method for industrial products, “het innovatiestappenmodel” [Roozenburg, 1991]. An orientation phase is absent in these models but will be covered in this project. The directions of the implementation will be covered but the actual implementation will not be part of this project (and is part of the mentioned models). After completing this project, taking a (possible) investment decision and starting the development phase will still take a considerable amount of time. The following figure shows the research model and the different phases are explained on the next page.

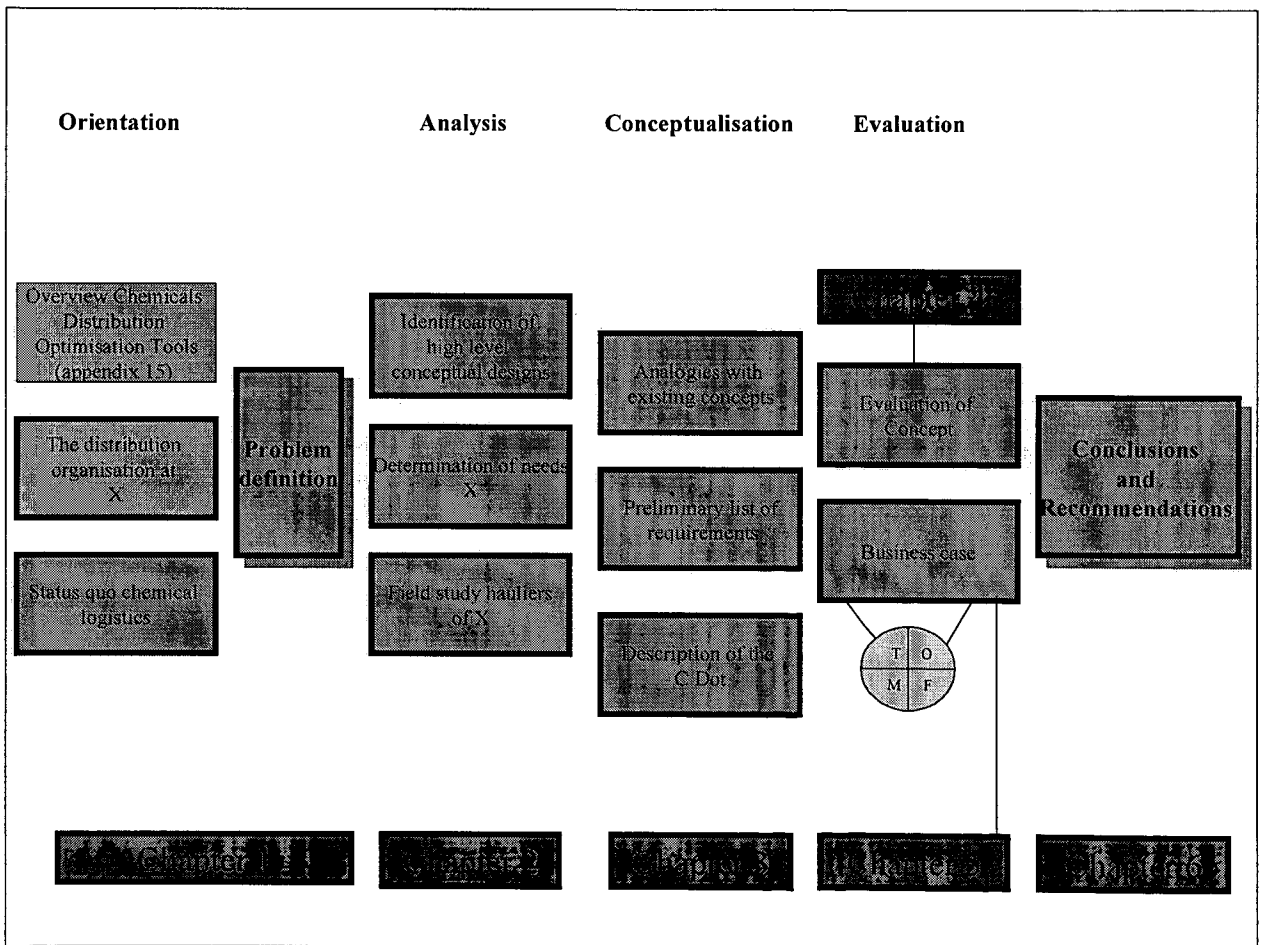


Figure 1.2 Research model including chapter division

³ The conditions refer to the market conditions as well as to the internal conditions

The following phases can be distinguished in the research project:

1. Orientation phase: To start with, an orientation phase is conducted. Chemical transport in theoretical and practical view plus the company X are acquainted with. Furthermore a desk study on (potential) Chemicals Distribution Optimisation initiatives is carried out (appendix 15).

2. Problem definition phase: This phase consists of the problem discussion, definition of scope and goal of the project. Furthermore the (initial) research model is drawn up.

3. Analysis phase: The needs of both the chemicals distribution industry and X will be determined. High level solution directions are identified and a choice is made for one model, constituting the basis for the following phase.

4. Conceptualisation phase: A preliminary list of requirements for the C Dot is composed. To better understand the C Dot's functioning, analogies with existing concepts are discussed. An extensive description of the system including benefits to the different stakeholders will be given.

5. Evaluation phase: The necessary conditions and (potential) barriers to successful implementation are defined. Furthermore the C Dot will be discussed in a business case on the elements finance (f), organisation (o), market (m) and technology (t).

6. Conclusions and recommendations: The final phase consists of a summary of the research findings and recommendations to X are given.

C2. Executive summary

This research project conceptualises a Chemicals Distribution Optimisation Tool (here defined as the C Dot). The current chemical transport system is characterised by several inefficiencies and the shippers are indirectly paying for these. Empty driven kilometres are calculated in transport tariffs and cleaning decisions are not always made in the most cost efficient way. The non-efficient use of vehicles is identified as the most important deficiency and influenced by congestion, resolution will become even more urgent. Transportation costs will come under even more pressure, due to increasing diesel prices and environmental taxes. According to X, hauliers do not show enough high-impact improvement initiatives. Therefore X is evaluating the option to initiate a solution itself, which will optimise chemical transportation of bulk liquids in Europe.

The following research goal is defined:

Delivering an evaluated conceptual design of a Chemicals Distribution Optimisation Tool, addressing the principal Chemicals Distribution inefficiencies and matching the requirements of chemical producer X.

The orientation phase of this project examines the status quo of chemical logistics. It is concluded that chemical transport is quite different from conventional transport. This is mainly the result of the specific characteristics of the chemical products that need to be carried (i.e. hazardousness of the product, temperature sensitivity, aggressiveness, and reactivity). Chemical shippers are not executing the transportation themselves but they are outsourcing to specialised hauliers under long term contracts (mainly region-oriented). For X the transportation costs constitute a large share of their cost-to-serve and therefore of total product costs. Small improvements in this area could have a significant impact.

In the analysis phase the needs of both the chemical transportation industry and X in a C Dot are defined. Six solution directions are identified and a choice is made to focus on a collaboratively dynamic planning system. Such an industry-wide system will dynamically optimise the total transportation network of its member shippers and hauliers. Allocation of transport orders to available vehicles will be done in the most cost-efficient way. Cross-company optimisation can not be reached in the current situation because of the existing transport contracts. The planning system would be the backbone of a network between shippers and hauliers. The main benefit of the C Dot will be the improved use of vehicles by the hauliers, which should eventually result in relatively lower tariffs to be paid by shippers.

The conceptualisation phase gives a detailed description of the C Dot as a collaborative planning system. Analogies of the concept with trip planning systems, hauliers' consolidation, collaboration and e-marketplaces are given. An important prerequisite for the success of collaborative planning is the changing of the current transport arrangements. The real benefit of the C Dot will only be exhibited if the allocation of transport orders to hauliers can be done without fixed shipper-product-region-haulier combinations. Business rules will gradually take over the role of the contracts and will, amongst others, reflect the preferences of the shipper with regard to quality and costs of his hauliers. Allocation of shippers' transportation orders will take place on the base of business rules, availability plus current position of (adequate) vehicles, and total network costs.

The evaluation phase gives an overview of C Dot underlying strategic issues and critically considers the concept.

It is concluded that transport orders of other chemical shippers will be necessary to constitute a balanced and sufficiently large package of transportation flows. Shipper Y and Z are identified as potentially interested chemical shippers. The total chemical sales of these three companies together accounts for almost 6% of total chemical sales in Europe and for almost a third of the sales of the largest shippers.

For the large hauliers of X, the average share of X's business in relation to the hauliers' total business is estimated to be 8%. This is a only a small percentage and the assumption is therefore made that hauliers will only embrace the C Dot if the C Dot shippers will together constitute the larger share of their business (more than 50%). X should therefore only start the C Dot if other shippers participate. But shippers could pursue different, non-C Dot matching logistics strategies such as a lead logistics provider. Furthermore, more inbound Europe located shippers currently already take advantage of the industry's dominance of inbound Europe oriented transportation flows. It is unlikely that these shippers would share their benefit with less advantageously located shippers.

Including large hauliers in the definition and development phase will be essential; they have the experience in both transport planning and collaboration with colleagues (freight-exchange). But it is expected that hauliers will not accept the C Dot concept with open arms. Hauliers prefer long term contracts with volume indications in order to have guaranteed volumes to justify the necessary investments. Hauliers are unlikely to give away the operational planning of transportation and become dependent on the C Dot for the allocation of orders. The C Dot will only be beneficial for hauliers if the concept will be able to outperform the optimisation that is currently being done within the existing contracts. This might not be possible if the shipper's current strategy with regard to transportation (in terms of costs, quality and preferred suppliers) does not radically change. In that case, business rules will reflect the mentioned strategies (e.g. preferred supplier) but will induce a decreased level of optimisation.

The C Dot will entail the building of a network organisation, which will be complex and time-consuming. Each individual company will pursue its own company goals and will even in a network organisation try to maximise its own profit.

The conclusion is drawn that the C Dot concept could in theory be beneficial. But in order for the C Dot to show its full potential, other shippers' participation should be guaranteed, potential hauliers' resistance must be overcome and necessary changes to the current transport arrangements should be made. The chance of finding sufficient shippers and hauliers willing to join the C Dot is estimated to be small. X should certainly not start this initiative without the mentioned critical conditions being satisfied.