Selecting a distribution structure for product-customer combinations : designing a framework for Philips Semiconductors

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SELECTING A DISTRIBUTION STRUCTURE FOR PRODUCT-CUSTOMER COMBINATIONS

DESIGNING A FRAMEWORK FOR PHILIPS SEMICONDUCTORS

ABSTRACT AND SUMMARY

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ABSTRACT

This report covers the results of a study investigating the suitability of changing distribution structures for a product-customer combination.
Flows from Far East region to Europe have been analysed and new alternatives have been formulated. A framework has been developed which considers as well as customer service requirements and total distribution costs in order to evaluate the distribution structures.

EXECUTIVE SUMMARY

This research project has been carried out from May 1999 to January 2000 at Philips Semiconductors, which is part of Philips Electronics N.V. The activities of the Philips group, organised in product divisions, are spread all over the world.

Research project inducement

Philips Semiconductors is continuously concerned with improving their distribution network. At the moment there is one central warehouse in each region, which serves all customers in that region with multiple services. Philips Semiconductors knows, however that the current distribution structure with one warehouse in Europe for all customers is not suitable for all customers and products because the company suspects that the same or better services with lower costs can be offered to the customer with another distribution network.
To minimise total costs with a certain customer service level Philips Semiconductors suspects that different distribution alternatives in a distribution network are suitable for different product-customer combinations.

Research problem

For Philips it is not clear how the supply chain from assembly and test centers to the customer must be designed to make this differentiated service possible against minimal total costs.

Research central question

What distribution alternatives with a certain customer logistics service level should be used for which product-customer combination in order to minimise total costs? What is the feasibility of creating an alternative distribution structure?

Research assignment

Design a framework in which can be determined which distribution alternative is suitable for which product-customer combination. Determine also the feasibility of an alternative distribution structure.

This framework should review the following performance criteria of the distribution alternatives:

- Distribution costs (stock keeping costs, transportation costs, handling costs, interest on capital, control costs)
- Customer Service requirements (fixed order lead time, delivery reliability)

Research Methodology

In a study where alternative distribution structures are determined, first the customer decoupling point (CODP) has to be determined for a product-market combination.

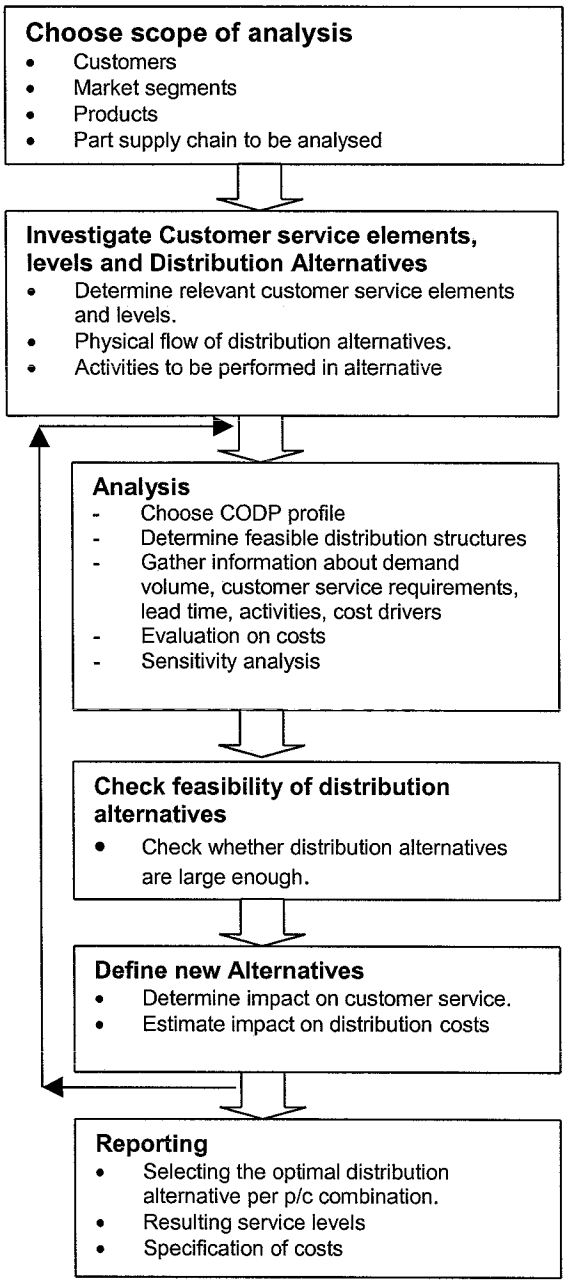
The customer order decoupling point is a central concept in this study and can be described as: *The point that designates how far an order penetrates in the production or distribution process from the provider of that product or service.*

Research framework

To answer the central question a framework is developed to support decision making about which distribution alternative to use for which product-customer combination.
The framework is displayed below and follows the research steps which are outlined below.

Product, customer process and goods flow characteristics

First the product, customer and goods flow characteristics are determined. This analysis is necessary to design distribution structures and to evaluate new distribution structures for a product-customer combination on feasibility.



Customer service requirements

From customer logistics service analysis first relevant customer logistics service elements are determined for customers of Semiconductors. Fixed order lead time, flexibility and delivery reliability are perceived most important compared to frequency of delivery, delivery quality, information about delivery time, availability, order and shipment status. For customers logistics service levels are determined.

Alternative distribution structures

Ten suitable alternative distribution structures have been determined, based on the analysis in the previous step. For all alternatives, activities, applications, advantages and disadvantages are determined. The distribution alternatives serve as input for the analysis.

CODP profiles

In order to segment products and customers to eight feasible distribution structures, first it needs to be established which distribution structures can meet the requested lead time of a product-customer combination.

In principle only distribution structures that can meet the fixed order lead time are feasible and will be considered and evaluated on distribution costs in the last step of the analysis. Distribution structures that can meet the requested lead times belong to a certain decoupling point. A decoupling point makes a certain range of lead times possible. Based on actual throughput times belonging to a CODP the CODP profiles can be distinguished. All product-customer combinations are allocated to one of this CODP profiles.

An influence model has been designed, which can be used in the decision to split up different customers and products to different CODP positions. This influence model considers customer service, customer risk and product risks in the decision which CODP profile a certain product-customer combination is allocated to.

Cost model

In a second step cost and customer characteristics determine which distribution structure should be chosen for a product-customer combination in a chosen decoupling point.

A cost model has been developed to compare costs of different feasible alternatives of a product customer-combination belonging to a certain CODP profile.
An Activity Based approach is followed to allocate indirect costs to the different distribution structures per product-customer combination. This approach consists of the following steps:

- Define activity centers
- Identify activities in an activity center
- Determine cost drivers per activity
- Link tariffs to activity
- Allocate costs to activities

The following activity centers are considered in the analysis

1. Carrying inventory
2. Handling
3. Transportation
4. Control

Furthermore, variables that influence costs and relations with cost drivers are analysed.

Sensitivity analysis

Sensitivity of the alternatives to changes in circumstances is determined.
As the environment of international distribution is very dynamic, a lot of external factors can have a significant impact on the efficiency of distribution alternatives. The sensitivity of the alternatives to these factors needs to be investigated.

Feasibility distribution structures

After evaluating the suitability of distribution structures for individual product-customer combinations, feasibility of a specific distribution structure has been checked.
When the flow of products of a specific distribution structure is not 'large' enough, this distribution structure will not be feasible and consequently not be implemented.
Further total costs resulting from the new distribution of volume over the alternatives has been estimated.

Case studies

The working of the framework has been tested for a selection of product-customer combinations for different levels of aggregation. A representative selection of product-customer combinations has been considered because general conclusions must be drawn about suitability of alternatives for certain product-customer groups.

Results of cost differences of alternatives between product groups

From the results in the appendices on all levels of aggregation can be seen that in case of standard discrete products the alternatives with delivery via the RSO warehouse generate far

lower costs than alternatives with direct delivery. Furthermore, in make-to-stock cases, alternatives with **sea** bulk transport are very attractive from a cost perspective.

In case of non-standard discrete products, standard IC products and non-standard IC products it depends on shipment size, customer and product characteristics which alternatives generate lowest costs. Only in case of very high value weight densities, a high shipment size, alternatives with direct delivery generate lower costs than alternatives with delivery via RSO warehouse.

Results of cost differences of alternatives between customer groups

On the first level of aggregation differences in costs between alternatives are caused by customer characteristics like order frequency and shipment size. Customers with a relatively high order frequency generate higher handling costs. Customers with a relatively low shipment size generate high delivery transport costs. Alternatives with direct delivery compared to alternatives with delivery via RSO warehouse have relatively lower total costs with a higher customer shipment size and a relatively high order frequency.

Results of cost differences of alternatives with different CODP

In the cases with produce to stock (central or customer stock) inventory costs cause a larger part in total costs than in cases with assemble or produce to order. Consequently cost differences are smaller between alternatives with direct delivery and truck delivery via RSO warehouse in case of assemble to order. Alternative 1,3, 4 and 6 appeared to be dominant structures.
The cases with customer or consignment stock, described in Appendix B10 show that the customer stock points can best be replenished by RSO stock. Total stock levels are lower because in case of out of stock, stock is easily replenished by higher echelon stock in RSO warehouse. The case in appendix B20 shows that customer stock can best be replenished from die with direct delivery.

Results sensitivity analysis

From sensitivity analysis in Appendix D the following results can be observed:

- A different shipment size has a major impact on total costs (between 10% and 30% difference)
- A different capital charge also has a major impact on total distribution costs (between 2% and 39% difference)

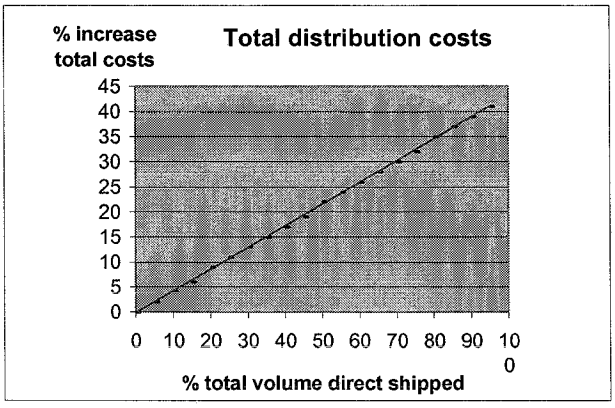
The following effects have less impact on total costs than the two effects above:

- A different RLIP
- A different variation of order demand and variation in order arrival time
- Price difference IDC relative to RDC
- Scale effects in transportation costs
- Scale effects in costs for handling

Results feasibility analysis

From the product volume, which is assemble to order, 8 % of total product volume or approximately 2400 items should be shipped directly solely based on minimal distribution costs.
From the product volume, which is produced to stock, 7% of total product volume or approximately 1000 items should be shipped directly solely based on minimal costs.

The other 85 % of total product volume can be shipped through the RSO warehouse. In the table below total costs increase with a higher volume which is direct shipped.



In the selection of distribution alternatives, functions of product characteristics have been drawn up to support decision-making.

Conclusions with respect to approach and framework

Application areas
The framework can be applied to support decisions at tactical and strategical level. To support these decisions the framework can be used to:

1. Select the optimal Distribution Alternative for a product-customer combination
By applying the framework, the optimal distribution structure can be determined for an individual product customer combination from an origin to a certain destination.

2. Determine relevant customer service elements and levels.
The framework can be used to determine relevant customer service elements and levels in a consistent way for customer groups or individual customers.

3. Define and evaluate new distribution alternatives
The framework can be used to define new distribution alternatives in a consistent way. Alternatives are defined in terms of its distribution elements. The new alternatives first have to meet customer service requirements. Secondly, costs impacts of these distribution alternatives are determined. The effects thereof on costs for each activity have to be determined or estimated.

4. Make trade-offs between distribution costs and customer service
The framework can be used to test the influence of different customer service levels on costs. In a way a trade-off can be made between the extra service which is offered to the customer and the costs which would result of this. Examples of trade-offs are:
- Extra costs of a higher delivery reliability.
- Extra costs of a shorter fixed order lead time.

5. Sensitivity analysis to test the influence of key variables
The framework can also be used to test the influence of certain key variables on the different distribution alternatives. By examining this, it can be tested whether the distribution alternative is still optimal if key variables change. In this way it can be validated how robust the selected solution is for changes in the future. It is also possible to test different values of variables, which are hard to estimate.

Repeating the approach
For Philips Semiconductors it is important to repeat the developed approach in the future. Logistics Operations will provide support in applying the approach for different business units in their specific situation. Within Philips Semiconductors the expertise has been developed to

provide support to other organisational units who use the approach. However it is recommended to give attention to the conditions for a successful repetition of the approach.

- Although the required information for the framework can be obtained within the Philips organisation, the information is not in an suitable format to be processed easily. The format of the basic information requirements should therefore be improved.
- The analysis and reporting has been mainly a manual task, which is supported with simple spreadsheets. The effort required can be reduced significantly if a software tool can be used for the processing of data, the aggregation of results and the presentation of report formats.

Conclusions with respect to the case studies

Important product-customer characteristics
From analysing the results of the case studies it became clear which product and customer characteristics have the biggest impact on the choice of the distribution structure.

This analysis is done by analysing sensitivities of characteristics in the selection of cases. Sensitivies of characteristics in product-customer combinations and between product-customer combinations have been compared.
From this analysis the following characteristics have a critical influence:

1. ***The value density of the product (measured in HFL per kg):***
   The lower the value density of the product, the higher the impact of transport costs on distribution costs. The higher the value density of the product, the higher the impact of inventory costs. Alternatives with direct shipment become more favorably.

2. ***The average shipment size of a customer transport shipment (measured in kg):*** The higher the transport shipment size, the lower the impact of transport costs on distribution costs. Alternatives with direct shipment become more favorably in relation to RDC shipments.

The following characteristic has less influence than the two characteristics above:

3. ***The sales volume per order line of the product (measured in units/order line):***
   The lower the sales volume per order line, the higher the impact of handling costs on total distribution costs is. Alternatives with direct shipment become more favorably.

However the following factors which have a major impact on costs may never be ignored:

1. Scale of operations
The scale of operations has a major impact on distribution costs. Costs of order handling are very sensitive to scale effects. In the case of Philips Semiconductors with higher demand volumes, lower tariffs per order line or per kg can be obtained from logistic service providers. For a distribution alternative it is, from cost perspective, important to have a sufficient economy of scale to operate efficiently.

2. Consolidation effects
The product-customer combinations are analysed individually. This means that the impact of the distribution of one product-customer combination on the distribution costs for other product-customer combinations can not be quantified. In case of different distribution alternatives for different product groups to the same customer will result in extra costs for handling but lower costs for transport because shipment weights will be higher.

Recommendations

Immediate follow-up research:

- Although manufacturing capacity plays a role in the choice which CODP to use for which product-customer combination, this factor is not outlined in this project. It is thus strongly recommended to design a model to determine a **CODP** for each product-customer combination where **all relevant factors** are included. Customer service, product risks and manufacturing capacity should be included as relevant factors.

- For the determination of feasibility of alternatives a simple model without inventory is used because the cases showed that costs for inventory in stock points do not have a significant impact on the outcome of the question which alternative to use. However, when the cost model is implemented in an automatic system it is strongly recommended to include this stock model in a system. Moreover in a follow-up study effects of variation in order demand and different service levels on stock levels should be investigated.

- In this research only inventory after assembly has been investigated. It is also strongly recommended to include also **inventory before assembly** in a follow-up analysis. When including also die stock in the analysis a divergent multi-echelon stock point network exists. When networks of stock points are analysed instead of single local stock points significant gains in stock level reduction can be obtained.

Feasibility of distribution structures for product groups:

- The results in the appendices on all levels of aggregation show that in case of standard discrete products the alternatives with delivery via the RSO warehouse generate far lower costs than alternatives with direct delivery. It is thus recommended not to give first priority in starting direct delivery for this group of products.

- In case of standard discrete products, in make to stock cases, alternatives with **sea** bulk transport are very attractive from a cost point of view. Sea transport should thus be further investigated as a suitable alternative for standard discrete products.

Provide support in the application of the approach

Being able to repeat the approach will be critical for the eventual benefits that can be expected for Philips Semiconductors. To achieve these benefits the following actions need to be undertaken:

- Support the BU's and the rest of the Sales organisation in the application of the approach by making expertise from cases available.
- Provide expertise by customised training, workshops and first-line support.
- Provide well-documented working procedures and a manual for potential users of the framework.
- Develop and support a flexible software tool to facilitate analysis and reporting.
- Improve and standardise the approach used.

Longer term follow up, aimed at guaranteeing long-term benefits for Philips Semiconductors

To obtain long term benefits for Philips Semiconductors, the repeated approach is not sufficient. The information which can be obtained needs to be utilised to its full potential:

- Make sure that BU's are self-supportive in using the approach when necessary for decision support.
- Set up a structural reporting and monitoring system for the total distribution costs at the level of product-customer combinations.
- Measure and monitor the delivery reliability and lead times for the complete supply chain at the level of product-customer combinations.