MASTER

Consolidation in logistics : implications of re-designing a distribution network : executive summary

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CONSOLIDATION IN LOGISTICS

Implications of re-designing a distribution network

Eindhoven University of Technology

Procter & Gamble Belgium/Netherlands

Executive Summary
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Consolidation

in

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Executive Summary

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Abstract

This executive summary describes research carried out to identify implications of product flow consolidation and site consolidation at Procter & Gamble Belgium/Holland. A structural approach has been used to map implications for customer service and total logistic costs. A customer assessment tool has been developed and successfully implemented, which supports advice to customers on ordering behavior. An Activity Based Costing and Decision support model has been used to make a trade-off between two possible locations for a consolidated distribution center.

Executive summary

Procter & Gamble
In 1837, William Procter and James Gamble founded Procter & Gamble (P&G) in Cincinnati, Ohio. The company started as one of eighteen soap and candle businesses in Cincinnati. In 163 years, the company has grown into a multinational company, employing over 110,000 people, operating in 70 countries and marketing over 300 brands. P&G is striving to provide products of superior quality in the Fast Moving Consumer Goods business and develops and sells consumer goods mainly in the product categories paper (for example Pampers, Always, Tempo), health & beauty care (for example Pantene, Oil of Olaz), fabric & home care (for example Dreft, Ariel, Antikal) and food & beverages (for example Pringles).

Trends and Developments
In the downstream supply chain, shown in figure 1, several trends and developments for the Fast Moving Consumer Goods business have caused P&G to make a strategic choice to consolidate in product flows and in the distribution network.
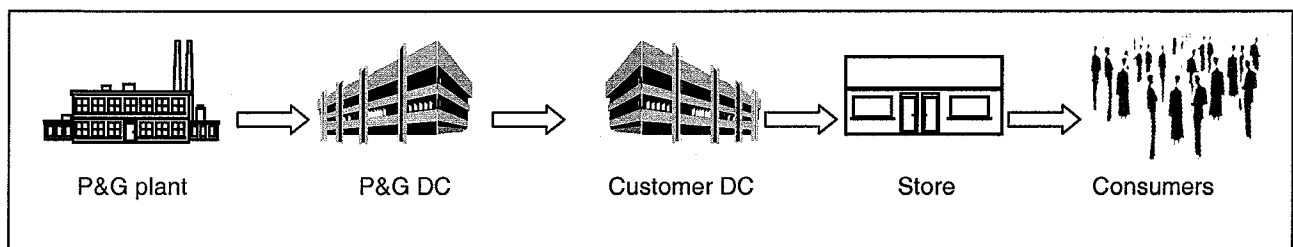

Figure 1: Downstream supply chain

For consumers, mass individualization together with increase of income leads to higher demands regarding freedom of choice, assortment and convenient efficient shopping. Consumers have become picky and will switch to another retailer if their choice of product is unavailable.

To improve shelf availability and decrease inventory, some customers (flow through customers) apply the concept of continuous flow distribution; shipment sizes become smaller and more customized; a wide variety of products in small batches is delivered daily. Because of the lower load factor, retailers are looking for opportunities in consolidation of transport from DC to store. There are other customers (buy and hold customers) that seek advantage in buying large volumes and benefit from quantity discounts obtained. The customers' distribution center (DC) structure consists of a network of specialized and regional DCs. Because of concentration and the benefits of scale, the number of DCs is decreasing. This will result in less, but thicker goods flow from the manufacturers to the retailers. In the long term, it is predicted that take-overs and mergers at customers and manufacturers will continue.

In order to respond to the urge for more efficiency in the supply chain, P&G endorses the principles of Efficient Consumer Response (ECR). ECR is defined by the ECR Europe Executive board as "*working together to fulfill consumer's wishes better, faster and at less cost*". The aim of ECR is to apply a total system view to eliminate all activities that do not add value for the end consumer and to encourage all those that do. ECR can be seen as a system in which accurate information and products flow quickly between the production lines and the cash desk (figure 2). Efficient replenishment, efficient assortment, efficient promotions and efficient product development are the four areas in which ECR seeks to respond more efficiently to the customer's demands.
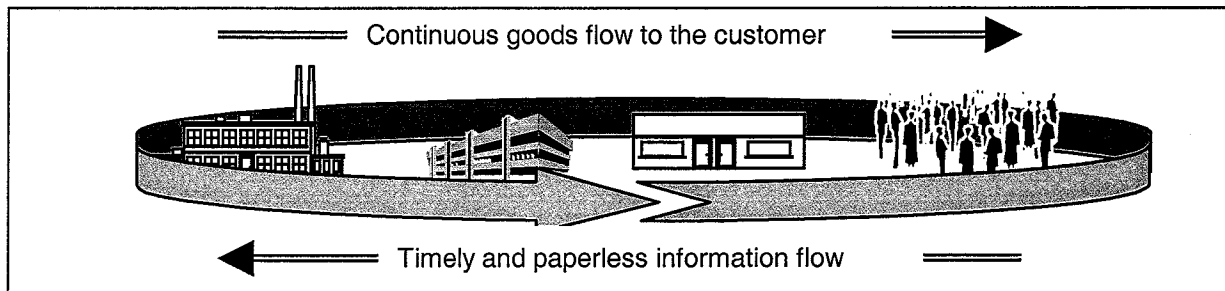
Figure 2: Efficient Consumer Response

P&G aims at maximum efficiency and effectiveness in the logistical and administrative processes in order to minimize supply chain costs. The ultimate goal is to create maximum value for the consumer. This strategy is made concrete in the logistical program at P&G: Streamlined Logistics (SLOG). The SLOG principles can be described as follows: rewarding for efficiency, forward passing of savings, transparency and simplification. Within the SLOG program, discounts are offered to the customer for efficient supply management and use of enabling technologies such as EDI (Electronic Data Interchange).

The current step taken in streamlining logistics is the development of a program for the complete European market. In the European vision, a Euro-pricelist with Euro Trade Terms (ETT) will be offered to customers. Focus lies on both large key customers and small customers in new trade lanes, like kiosks, bars and gas stations. Therefore, fixed ordering quantities and matching efficient ordering discounts were determined, which are called brackets.

The project description
Within P&G, a thorough analysis was done on the European distribution network to create a DC siting masterplan. In terms of logistical costs, going to full ex-producing plant delivery would maximize the possible reduction in transport and operating costs. However, this scenario would lead to substantial increases in customer inventories and would not support the needed responsiveness and multi-category flows. The other extreme, 100% of volume consolidated through regional DCs in which different categories are combined would represent a significant transport/operational on-cost due to increased inbound freight costs and double handling. Therefore, the conclusion of the study was to create a two tier DC network. This would consist of a pan-European coverage of multi-category regional DCs, supported by direct customer shipments from producing plants. For each country, recommendations were made on location for regional DCs. For Belgium/Holland, the location was recommended to be location B.

As the costs presented in the research were based on model simulations, they should not be used to develop a single "Euro" recommendation for investment and implementation. Each major project or country had to be separately justified and recommended using actual costs and associated net outside sales growth opportunities. Concurrence was needed that the distribution vision and masterplan was consistent with GBU sourcing plans and supply/distribution operating strategy. For P&G in Belgium/Holland, this has been done in this project. The following project description emerged:

Analyze and define the implications for customer service and costs for setting up a full service distribution center for the Benelux for all parties involved in the supply chain.

Design the most optimal distribution structure for P&G trade in the Benelux.

Customer service has been defined as "*a customer focused business philosophy which integrates and controls all elements concerning the interface with the customer within an optimum of costs and service*". Service is the satisfaction of customers concerning the logistical customer service elements. Of interest for this project are the elements service level, responsiveness and customer inventory level. These elements are related. This is shown in figure 3.
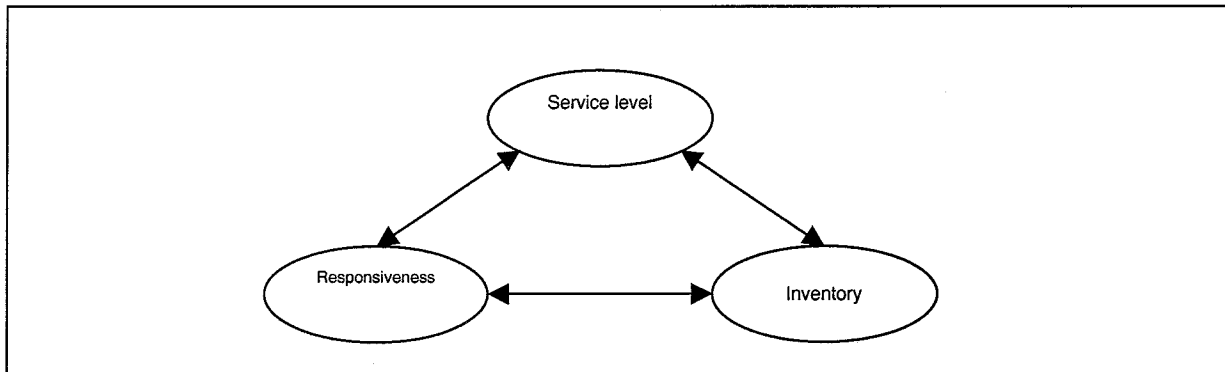

Figure 3: Relationships between responsiveness, service level and inventory

Consolidation, the joining of different product flows into one flow, improves responsiveness. Smaller batches of products can be delivered more frequently with a higher truckload efficiency. The decrease of the replenishment time has impact on the needed inventory level; this level can be set lower, as a smaller period of time between two replenishments needs to be bridged. The service level is fixed as a target.

In the traditional view, supply chain advantages are only seen as internal costs to be reduced. In the current view, supply chain advantages (scale and breadth) should be leveraged to the advantage with customers and is seen as a competitive opportunity. The target of product flow consolidation at P&G is therefore to improve sales and reduce costs by:
- improving customer service
- decreasing total logistical costs

Total logistic cost components are defined as follows.
- Transport costs

The freight costs paid to the haulier. Drivers are load factors, average volume and weight and distance to the delivery address.
- Handling costs

Costs involved with all activities related to moving goods. Physical handling and administrative handling are usually distinguished. Amount of handled pallets is a driver, as well as ordering units.
- Storage costs

This includes costs of the buildings and space that is used to store the products. The occupancy of the pallet spots is important.
- Interest costs

Interest costs for inventory in the DCs and pipelines. Drivers are the average number of days inventory in the DC and delivery lead-time, during which interest is accounted for pipeline inventory.
- Reconditioning costs

Costs involved with changing the package, f.e. picking pallets for slow movers. The number of orderliness in which a picking pallet is composed is an indicator.

The design of the optimal distribution network focused on locating the full service DC. Two possible locations were indicated by Procter & Gamble, both situated near producing plants: location A and location B. A trade-off was needed to recommend the optimal location.

The approach that was developed to carry out the assignment is shown in figure 4. It integrates the 10-steps approach of Kempen/Keizer with the Aertsen research approach in which research is structured in a strategic, conceptual and realization phase.

Figure 4: Research model
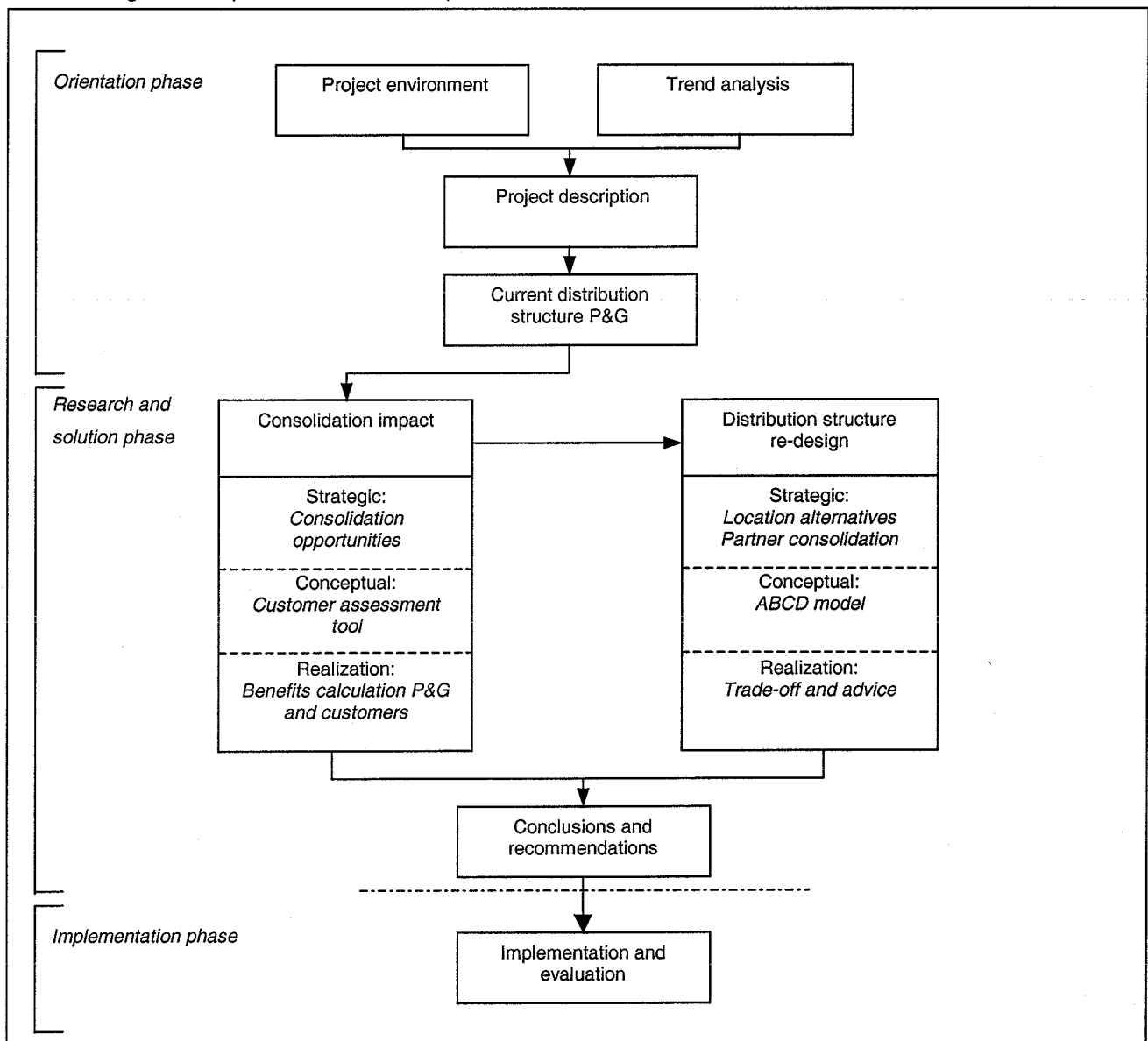
The implementation and evaluation of the product flow and site consolidation was outside the scope of the project. Next, consolidation impact for P&G and customers and the re-design of the distribution network are discussed.

Consolidation impact
In the strategic phase, opportunities of consolidation for customers and P&G were discussed. First, implications for customers were mapped.

Responsiveness is improved by product flow consolidation, because it creates the opportunity for more frequent deliveries in smaller amounts per product group in efficient truckloads. Consolidation can also affect the inventory level at customers. More frequent delivery shortens the time between two replenishments. The stock, which size is based on the demand in the time between two replenishments, can therefore decrease. Different customers have different consolidation opportunities. In order to find out which implications exist, customers were segmented based on their current ordering behavior. Each segment has different opportunities. New ordering behavior could be predicted, if it was assumed that customers would change their ordering behavior in line with the benefits they could achieve. Of course, in the end, customers decide in which brackets they want to order and via which trade lanes. This segmentation was therefore a starting point in discussion with Customer Team Logistics Managers and customers on eventual actual ordering behavior.

Segments were formed by two axes; the total amount ordered per shipment and the frequency of delivery. The total amount ordered is indicator for improvement in the bracket the customer ordered in. The frequency of the delivery is indicator for the opportunity of lowering inventories by more frequent delivery. Figure 5 shows the different possible segments.

		Frequency of delivery	
		High	**Low**
	FTL	Segment 1: efficient, high volume customers	Segment 2: low volume customers, discount sensitive
Total amount ordered	**LFTL**	Segment 3: flow through	Segment 4: low volume customers

Figure 5: Customer segments

Customers in segment 1 were expected not to change their ordering behavior, as efficiency was high and the maximum discount for efficient ordering was already obtained. The ordering behavior of customers in segment 2 was clearly driven by discount. The analysis of cost savings obtained is needed to predict the future ordering behavior of these customers. In segment 3, customers choose for small batches per product. By combining the small batches in one truck load, efficiency benefits can be obtained and more discount can be obtained. In segment 4, customers can benefit from both more efficient transport as more frequent delivery. These are mainly small customers. It became clear that product flow consolidation could be beneficial for both low volume customers and high volume customers. A more detailed customer assessment was needed in which costs for different alternative order quantities and frequencies were compared.

Analysis of performance indicators and product characteristics showed that for P&G, benefits could be obtained by reduction of orders, increased full truck shipments, diminishing of inventory level by higher frequency of delivery and reduction of costs. The implications for P&G could be determined if the future customer ordering behavior was known.

In order to predict customer ordering behavior, a customer assessment tool has been designed, in which a trade-off calculation is made between discount obtained and total logistic costs for fixed order quantities. In order to do this, an inventory level calculation model has been included, in which the effect of different order quantities on customer inventory level could be calculated. A pilot has been carried out, which showed the design of the model was useful and could be implemented. The model was used to predict customer ordering behavior.

Total logistic costs benefits for the customer assessment tool outcomes could occur in handling savings, storage savings, interest savings and higher discounts.

- Handling savings:

For the assessed customers in Belgium, the number of orders was expected to decrease with x%, or x orders. This is a total saving of fixed handling costs of EUR x yearly. On average per customer, this is x EUR.

- Storage savings and interest savings:

These savings were driven by reduced inventory. For customers who were expected to decide to order in a higher bracket, inventory would increase. Extra costs were calculated to be on average EUR x yearly per customer delivery point for interest costs and EUR x yearly for storage costs.

- Higher discounts:

Higher discount was given to those customers that were predicted to decide to order in a higher bracket. On average, the discount increased with x% if a customer moved from less than full truck delivery to full truck delivery. This is on average x% of the basic acquisition costs.

For P&G, savings could be found in decreased total logistic costs.

- Transport costs

These costs were expected to decrease for those customers that decide to order more efficiently. The real savings in transport costs are depending on the location of the full service DC. In Belgium, the average number of pallets per truck was expected to increase from x pallets per shipment to x pallets per shipment. In Holland, the average number of pallets per shipment was currently x. This was expected to become x pallets per shipment.

- Handling costs could be decreased when less orders needed to be processed. On average for The Benelux, the fixed administrative costs were estimated to be x EUR per order. Therefore, the reduction in number of orders (x) would result in savings of x EUR yearly.

- Storage and inventory costs could be diminished if customers order in lower brackets. However, only x% of the pallets was expected to be delivered more frequently in smaller batches. The effect on inventory was therefore assumed to be negligible.

- Reconditioning costs could be influenced if ordering units become less efficient (cases instead of full layers and full pallets). This could happen if customers were predicted to order in lower brackets than current brackets. Costs would increase if more pallets need to be made up from different categories in one pallet. Picking a full pallet costs less than assemble a pallet before picking. No extra reconditioning costs were foreseen, as only x% of the pallets might need extra reconditioning.

Re-design of the distribution network
Next, a trade-off was made between different locations for the full service DC. First, a Greenfield study, based on transport distance and freight showed that the optimal location for the full service DC was situated in country A, only 40 km from location A. Furthermore, advantages and disadvantages were mapped for consolidation outside the own distribution structure. It showed that a research for this option would involve extensive research to find a suitable candidate and was not possible within the time frame for this project. Based on this strategic research, it was decided to make a trade off between the two locations location A and location B.

The needed trade-off is shown in table 1 on the next page. The split stock effect was due to the fact that location B was assigned to be full service DC for country B. If the stock for B/NL was to be stored inlocation B, the inventory could be combined with the inventory for country B. Pipeline inventory effects for shuttles between the two DCs for the products produced at the nearby situated plants need to be calculated. The warehouse activities needed to be assessed for efficiency performance; this indicates the

amount of resources needed to perform the activities. Inbound transport (between plants and full service DC) and outbound transport (between full service DC and customers) needed to be assessed.

Table 1: Location A and location B trade-off

	Inventory management	Warehouse/handling	Transport
Full service DC located in location A	• Split stock effect paper full service DC • Pipeline interest shuttle location A -> location B	• Efficiency performance	• Inbound shuttle Pampers needed • Inbound transport efficiency • Outbound transport efficiency
Full service DC located in location B	• Pipeline interest shuttle location A -> location B	• Saving overhead location A • Efficiency performance	• Inbound shuttle location A products needed • Inbound transport efficiency • Outbound transport efficiency

Using an Activity Based Costing and Decision support model, the relevant costs for the two sites were compared and implications for efficiency and effectiveness were assessed. In table 2, the results of the cxalculations are summarized.

x

Table 2: Results ABC calculation

Costs	Location A (EUR/year)	Location B (EUR/year)
Inbound transport	X	X
Outbound transport	X	X
Transport	**X**	**X**
Handling	X	X
Order picking	x	X
Storage	X	X
Overhead	X	X
Warehouse	**X**	**X**
Interest shuttle	X	X
Interest split safety stock	X	X
Inventory	**X**	**X**
TOTAL	**X**	**X**

The difficulty in the calculation was, that overhead was included in the tariffs for location B, but excluded from the tariffs for location A. In ABC calculations, overhead was assumed to be variable. For location A, overhead costs were x EUR yearly, for a capacity of y pallets. In order to make a comparison possible, the overhead tariff was calculated per pallet and added to the warehouse costs for location A. z pallets were estimated to be kept in the full service DC. This would cost x EUR for overhead.

From this calculation, it became clear that, given the calculation assumptions and using available data as input, location A is a cost optimum location for the full service DC. A sensitivity analysis showed, that the benefit in transport costs for location A was not to change for different shipment sizes, different tariffs or different total amount of pallets handled through the full service DC. For warehouse costs, no sensitivity analysis was carried out. No significant conclusions could be made for warehouse costs as the level of detail for the currently available overhead costs data was not significant enough. Inventory sensitivity analysis was not carried out, as these costs accounted for only 1% of total logistic costs.

Conclusions and recommendations.
Finally, the following conclusions could be made:
  1. **A customer assessment tool has been developed and successfully implemented.**
The tool supports prediction of future customer ordering behavior for P&G. Based on a trade off between logistic costs and discount given for efficient ordering, the model advises on optimal order quantities for customers. CTLMs have successfully used the model to assess their customer's ordering behavior. The tool gives insight in relationships between different logistic costs and sensitivity of changes in ordering behavior for inventory.

  2. **Consolidation improves customer service as P&G becomes more responsive for both small customers and large customers, according to the data output of the customer assessment tool.**
Using the information on customer ordering behavior as indicated by the customer assessment tool, implications of consolidation can be determined for customer service in Belgium/Holland. x customers (of x customers in total) are expected to decide to order more frequently in smaller batches. This accounts for x% of the total volume in pallets. These customers are mainly low volume customers. The other customers are expected to order more efficiently and thus obtain higher discounts. The customer assessment tool predicts that inventory levels for customers will not change significantly for customers that choose to order more efficiently, as the consolidation of product flows has a smoothing effect on inventory levels.

  3. **Consolidation of product flows is beneficial for both P&G and customers according to the output of the customer assessment tool.**
Logistic costs are diminished. Savings in handling costs are expected to be x% for customers (x EUR yearly) and x% for P&G (x EUR yearly). Transport efficiency for P&G is improved; currently, the average truck fill is x pallets per shipment. This is expected to increase to x pallets per shipment. Storage and inventory costs and reconditioning costs are expected to remain unchanged for P&G. Thus, overall, both P&G and P&G customers benefit from product flow consolidation.

  4. **Based on current available data, the ABCD model points in the direction of location A as optimal location for the full service DC.**
The ABCD model makes a trade-off possible based on costs for different locations for the full service DC. Savings in comparison to location B are mainly expected in the outbound transport costs (x EUR) and warehousing costs (x EUR). The total savings of location A account for x% of the total costs for location A.

  5. **A Greenfield study, cost analysis and sensitivity analysis point out that location A is favorably situated regarding total transport costs to customers in Belgium, Holland and Luxemburg.**

This conclusion indicates that the total transport costs are in all cases lower for location A. As these costs account for x% of the total logistic costs, this is a big advantage for location A.

The following recommendations are made:

1. It is recommended to implement and evaluate the consolidation of product flows.

In this project, consolidation of product flows has proven to be beneficial for both customers and P&G. Therefore, the consolidation of product flows should be implemented. Continuous evaluation of the benefits and impact on performance indicators will show the true benefit obtained from consolidation. As consolidation improves efficiency and effectiveness and reduces total logistical costs, it is a powerful tool in gaining competitive advantage.

2. It is recommended to perform further research in order to get better insight in overhead costs for both location A and location B.

The available data show very little level of detail in overhead costs. As the advice for the location of the full service DC is for x% driven by differences in warehouse costs, it is needed to get more insight in these costs. A sensitivity analysis for warehouse costs can further clarify the robustness of the advice.

3. It is recommended to further exploit the benefits of the customer assessment tool.

The tool has proven to be useful in Belgium and Holland and adequate for calculating optimal order quantity for customers. Yet more benefit can be obtained from this customer assessment tool.

- Use in Market Development Organizations in other countries

The set-up of the tool makes use in other countries possible. The same research needs to be carried out in other countries. Therefore, the customer assessment tool can be used to predict customer behavior for P&G customers in other countries as well.

- Use for different calculations

The customer assessment tool has already also been used to calculate inventory benefits and logistic cost benefits in a customer DC consolidation case. It is recommended to use the insights gained in relationships between order quantity, inventory level and total logistic costs for the aid of customers.

4. It is recommended to perform further research on the effect of consolidation in the supply chain on shelf availability and prices paid by consumers.

The ultimate goal is to make the consumer benefit from the logistic opportunities and discounts offered by P&G to customers. In this way, sales for both P&G and customers can increase. P&G should gain insight in the way customers deal with the savings they get passed on in the supply chain. Shelf availability and price are direct indicators of opportunities to increase sales.

5. It is recommended to research the impact of production on responsiveness.

Production was out of the scope of this project. However, the production capacity and the utilization rate are important factors influencing responsiveness and flexibility for customer deliveries. It is therefore important to gain insight in the effect production planning and capacity have on availability. It is recommended to perform further research in this area.

6. It is recommended to reach full alignment between Global Business Services and Market Development Organization on the implications of consolidation in product flow and sites.

During the roll out of this project, it became clear that personnel in GBSs and MDOs didn't agree on the benefits and drawbacks of consolidation. For personnel in physical distribution, it looked as if consolidation was going to influence logistic costs, effectiveness and efficiency of processes in a negative way. For personnel that were directly involved with the customers, consolidation benefits were numerous. This project made clear that consolidation offers opportunities for customers as well as opportunities for

improvement and cost savings in distribution. It is important that both GBS employees as well as MDO employees understand the impact of consolidation for both marketing and logistics. This will improve the shared motivation to implement the consolidated distribution network re-design.

7. It is recommended to align the data available in the different information systems at P&G.
For the research, two information systems were intensively consulted. These were the Logistic WorkStation for physical distribution information and SLOG Order Reporting for information on customer ordering behavior. In both systems, differences were found in variables used and definitions of variables and dimensions. Difference was also found in information available for Belgium/Luxemburg and Holland. For further compatibility and consistent use of information, it is recommended to make the data and variables more aligned.

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