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Title: **Redesign of the Control Model of the Catering Distribution Network of KLM**

Author: D.M. van Kleef

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Supervisor: Dr. ir. H.P.M. Veeke

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Redesign of the Control Model of the Catering Distribution Network of KLM

Master's Thesis

D.M. van Kleef

October 2012

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Faculty of Mechanical, Maritime and Materials Engineering
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Subject: **Redesign of the Control Model of the Catering Distribution Network of KLM**

Context

The commercial aviation industry is a very competitive market. KLM is struggling with the difficult economic climate due to ever climbing fuel prices and the results of the global- and euro financial crises. Yet KLM wishes to become the best service oriented airline in the world, as a way to stay competitive in the current and future market. As part of the overall inflight service, the passengers on each KLM-flight are offered catering services during the flight. The sort and amount of services depend on the flight length, the time of day of the flight, the destination and the booked class. For European flights (EUR), the entire catering load for both the outbound- and homebound flight can be loaded at KLM's main hub, Amsterdam Airport Schiphol. However, for the much longer intercontinental flights (ICA) this is not possible. This means that the catering load for the homebound flight must be prepared and loaded at the outstation (a destination where catering activities occur). KLM has a contract with a caterer at the outstation, which encompasses the responsibilities concerning loading of the homebound flights, responsibilities concerning the local inventory management and responsibilities concerning the preparation of business class meals. Because KLM wishes to serve the same products on each flight, there is a need to distribute catering products to the 58 outstations.
N.B. In this context the same product means that for instance the same sort of soda can is used for a specific soda, not that the entire catering product is the same on each flight.

Problem definition

Cabin Inflight Management is the department that is responsible for the catering activities of KLM. The product portfolio for the three different product groups (1) World Business Class (WBC), (2) the intercontinental economy class (ICA-M) and (3) European (EUR) is developed and maintained by the sub department Product Management. The operational management of the product portfolio is the responsibility of the sub department Network Supply Management (NSM). Therefore, NSM is responsible for the actual ordering and distribution of the catering articles. KLM has chosen to have a central warehouse at Schiphol Noord and distribute the catering articles to the outstations from the central warehouse. The distribution of articles to the outstations is done either by sea freight, air freight or by pantry outfits. The most important performance indicators are defined as the reliability of the inventory, the quality and the costs. However, there is neither absolute and objective knowledge about the performance concerning these indicators nor knowledge about the possibilities

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to influence these important process parameters in a controlled manner. Given the difficulties KLM faces, it is important to realize cost savings by improving the efficiency of the company. Therefore, the need for objective information about the performance of the distribution network and the ways to influence the performance is evident.

This research is focused on analyzing and understanding the global distribution of catering articles in order to thoroughly understand the problems KLM faces and to provide solutions to these problems.

Assignment

Analyze the current distribution network concerning catering articles and develop a new control model to monitor and influence the performance of the distribution network in order to improve the performance on the three main performance indicators: (1) reliability of inventories, (2) quality and (3) costs.

Execution

1. Analyze the current processes according to the Delft Systems Approach
2. Determine the relevant areas for improvement and corresponding problems
3. Formulate the definite problem statement
4. Clarify the boundary conditions needed to formulate objective standards with regard to distributing catering articles
5. Formulate the definite performance indicators which will be used to measure and evaluate the performance of the distribution network
6. Develop a control model for managing the central inventory and corresponding supply chain in order to assure the desired reliability of inventory, the desired quality levels and minimized costs
7. Develop a control model for managing the area inventories and corresponding supply chain in order to assure the desired reliability of inventory, the desired quality levels and minimized costs
8. Study relevant literature

The TU professor,

Prof. dr. ir. G. Lodewijks

The TU supervisor,

Dr. ir. H.P.M. Veeke

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Preface

This report describes my research at KLM's division Inflight Services for my final thesis at the chair of Marine & Transport Technology of the faculty of Mechanical, Maritime and Materials Engineering at the Delft University of Technology.

The research was performed in the period of February 2012 till October 2012 at KLM's division Inflight Services at the department Network Supply Management, which is responsible for operating and improving the catering supply chain of KLM.

For me, the past nine months have been very meaningful. Not only was I given the opportunity to take the theoretical knowledge I had gained in the past six years as a student at TUD, and the past year and a half as a master's student in particular, and bring it to a real life situation; I also learned how it is to work in a big organization as KLM's and learn that the aviation industry with its versatile and dynamic character is an industry that I would love to work in.

Luckily, the overall results of my research and my participation in several projects have not proven to be useful only for myself, but also for KLM. The cost savings we have realized and the potential cost savings to be achieved in the future are promising. I would like to thank all colleagues at KLM for their enthusiasm and openness that led to our good collaboration.

I would like to particularly thank the persons responsible for the overall and daily supervision of this research:

- Prof. dr. ir. G. Lodewijks, Delft University of Technology
- Dr. ir. H.P.M. Veeke, Delft University of Technology
- B. Kroes, KLM Royal Dutch Airlines

Thank you for your criticism, your challenges and your meaningful insights.

As a concluding remark, I would also like to very much thank my parents, my sister and my phenomenal girlfriend for their ongoing support in any form during my study!

Dennis van Kleef,

Delft, October 18, 2012

Summary (English)

The commercial aviation industry is a very competitive market. KLM is struggling with the difficult economic climate due to ever climbing fuel prices and the results of the global- and euro financial crises. Yet KLM wishes to become the best service oriented airline in the world, as a way to stay competitive in the current and future market. As part of the overall inflight service, the passengers on each KLM-flight are offered catering services during the flight. The sort and amount of services depend on the flight length, the time of day of the flight, the destination and the booked class. For European flights (EUR), the entire catering load for both the outbound- and homebound flight can be loaded at KLM's main hub, Amsterdam Airport Schiphol. However, for the much longer intercontinental flights (ICA) this is not possible. This means that the catering load for the homebound flight must be prepared and loaded at the outstation (a destination where catering activities occur). KLM has a contract with a caterer at the outstation, which encompasses the responsibilities concerning loading of the homebound flights, responsibilities concerning the local inventory management and responsibilities concerning the preparation of business class meals. Because KLM wishes to serve the same products on each flight, there is a need to distribute catering products to the 58 outstations. N.B. In this context the same product means that for instance the same sort of soda can is used for a specific soda, not that the entire catering product is the same on each flight.

Cabin Inflight Management is the department that is responsible for the catering activities of KLM. The product portfolio for the three different product groups (1) World Business Class (WBC), (2) the intercontinental economy class (ICA-M) and (3) European (EUR) is developed and maintained by the sub department Product Management. The operational management of the product portfolio is the responsibility of the sub department Network Supply Management (NSM). Therefore, NSM is responsible for the actual ordering and distribution of the catering articles. KLM has chosen to have a central warehouse at Schiphol Noord and distribute the catering articles to the outstations from the central warehouse. The distribution of articles to the outstations is done either by sea freight, airfreight or by pantry outfits. The most important performance indicators are defined as the reliability of the inventory, the quality and the costs. However, there is neither absolute and objective knowledge about the performance concerning these indicators nor knowledge about the possibilities to influence these important process parameters in a controlled manner. Given the difficulties KLM faces, it is important to realize cost savings by improving the efficiency of the company, while maintaining or even improving the satisfaction rate of customers. Therefore, the need for objective information about the performance of the distribution network and the ways to influence the performance is evident.

This research is focused on analyzing and understanding the global distribution of catering articles in order to thoroughly understand the problems KLM faces and to provide solutions to these problems. The analysis was dedicated to the identification of problems in KLM's worldwide catering distribution network. Problems with respect to the performance on certain, by KLM defined, important indicators. These *key performance categories* were: (1) reliability of inventories, (2) quality and (3) costs.

These KPI's were compared with the important process criteria as defined by Bikker and In 't Veld. It can be concluded that with respect to the defined KPI's of KLM, the process criteria effectivity, flexibility and productivity are the most important ones. These factors are translated into measurable performance indicators, specified for this situation.

While zooming in on the catering distribution network, it became clear that three different sort of problems can be identified with respect to the performance of the system:

1. Important process control loops are not well executed or are non-existent,
2. The employees involved in the operational inventory management lack basic knowledge about the theory behind inventory management,
3. A lack of very substantial knowledge about the on board consumption of passengers.

The consequence of these problems is that in the current situation efficient replenishments for outstations based on actual needs are not possible, leading to non-optimal inventory management throughout the distribution network.

The control model for the distribution network has been redesigned, where the focus has been transferred to a demand-driven system: the network is aiming to satisfy all the passenger needs and at the same time doing this in the most cost efficient manner. The important input for the distribution is therefore an accurate forecast for both PAX numbers as well as the average consumption per PAX per stretch. New control loops have been designed, aiming at improving both KLM's performance, as well as the performance of third parties (suppliers, caterers and logistic service providers).

A quantitative case study has been developed in order to quantitatively back up the qualitative improvements as suggested in the renewed control model. By using a hypothetical outstation X and consumption data of EUR-flights, the case study showed that substantial financial benefits can be achieved by improving the stock levels, decreasing safety stock levels, decreasing non-performance- and regular transportation costs and improving DOW-impact. These savings sum op to three million euros and show the potential of the redesigned control model.

Summary (Dutch)

De commerciële luchtvaartindustrie heeft een uitermate competitief karakter. KLM worstelt met het moeilijke economische klimaat als gevolg van alsmaar stijgende brandstofprijzen en de resultaten van de financiële- en eurocrisis. Toch heeft KLM de ambitie om de beste servicegerichte luchtvaartmaatschappij van de wereld te worden, als manier om een competitieve positie te behouden in de huidige en toekomstige markt. Als onderdeel van de overall inflight service, krijgen alle passagiers op alle KLM-vluchten catering aangeboden tijdens de vlucht. Het soort en de aantallen services hangen af van de vluchtduur, het tijdstip van de dag, de bestemming en de geboekte klasse. Voor Europese (EUR) vluchten is het mogelijk om de volledige catering belading voor zowel de outbound- als de homebound vlucht in Amsterdam te beladen. Dit is echter niet mogelijk voor de intercontinentale (ICA) vluchten. Dit betekent dat de catering belading voor de homebound vlucht op een buitenstation (een bestemming waar catering activiteiten uitgevoerd worden) beladen moet worden. KLM heeft een contract met een cateraar op een buitenstation, waarin gespecificeerd wordt wat de verantwoordelijkheden zijn met betrekking tot het beladen van de homebound vluchten, het lokale operationele voorraadbeheer en de bereiding van business class maaltijden. Omdat KLM op alle vluchten dezelfde producten wil serveren is er behoefte om catering producten te distribueren naar de 58 buitenstations. N.B. in deze context wordt met dezelfde producten bedoeld dat het bijvoorbeeld om dezelfde blikjes gaat, niet dat het volledige cateringproduct hetzelfde is.

Cabin Inflight Management is de afdeling die verantwoordelijk is voor de catering activiteiten van KLM. Het productportfolio voor de drie verschillende productgroepen (1) World Business Class, (2) de intercontinentale economy klasse (ICA-M) en (3) Europees (EUR) wordt ontwikkeld en onderhouden door de CIM-afdeling Product Management. Het operationele beheer van het product portfolio is de verantwoordelijkheid van de CIM-afdeling Network Supply Management (NSM). Daardoor is NSM verantwoordelijk voor het bestellen en distribueren van de cateringartikelen. KLM heeft ervoor gekozen om via een centraal magazijn op Schiphol Noord de cateringartikelen te distribueren naar de buitenstations. Deze distributie vindt plaats per zeevracht, per luchtvracht of per pantry outfit. The belangrijkste prestatie categorieën zijn gedefinieerd als de voorraadbetrouwbaarheid, de kwaliteit en de kosten. Er is echter noch absolute en objectieve kennis over de prestaties aangaande deze categorieën, noch is er kennis over de mogelijkheden om hier gecontroleerd invloed op uit te oefenen. Gegeven de moeilijkheden waar KLM mee te maken heeft, is het belangrijk om kostenbesparingen te realiseren via verbeteringen in de efficiëntie, terwijl de passagierswaardering gelijk moet blijven of zelfs moet stijgen. De noodzaak om objectieve informatie te hebben aangaande de prestaties van het distributienetwerk is evident.

Dit onderzoek is gericht op het analyseren en begrijpen van de globale distributie van cateringartikelen om op die manier goed te begrijpen met welke problemen KLM te maken heeft en daar oplossingen voor aan te dragen. De analyse was gericht op de identificatie van problemen in het distributienetwerk. Dit betreft problemen aangaande de prestatie categorieën die door KLM gedefinieerd zijn. Deze categorieën waren de (1) voorraadbetrouwbaarheid, (2) de kwaliteit en (3) de kosten die daarmee gemoeid zijn.

Deze KPI's zijn vergeleken met de hoofdprocescriteria zoals gedefinieerd door Bikker en In 't Veld. Er is geconcludeerd dat ten aanzien van de drie door KLM gespecificeerde categorieën, de procescriteria effectiviteit, flexibiliteit en productiviteit de belangrijkste zijn. Deze factoren zijn vertaald in meetbare prestatie indicatoren toegespitst op deze specifieke situatie.

Door in te zoomen op het distributienetwerk rondom cateringartikelen zijn drie verschillende soorten problemen geïdentificeerd:

1. Belangrijke procesbeheersing wordt niet goed uitgevoerd of is geheel afwezig,
2. De bij het operationeel portfoliobeheer betrokken medewerkers hebben een gebrek aan elementaire kennis met betrekking tot voorraadbeheer en logistiek,
3. Een gebrek aan zeer belangrijke kennis over de consumptie van artikelen aan boord.

Het gevolg van deze problemen is dat in de huidige situatie het efficiënt herbevoorraden van buitenstations gebaseerd op actuele vraag niet mogelijk is, hetgeen leidt tot non-optimaal voorraadbeheer in de gehele keten.

Het besturingsmodel voor het distributienetwerk is opnieuw ontwerpen, waarbij de focus verplaatst is naar een vraag gestuurd systeem: het netwerk is erop gericht om alle behoeftes van de klant te kunnen invullen op een zo kosten efficiënt mogelijke manier. De belangrijke input voor de distributie is daarmee komen te liggen op accurate forecasts voor zowel de PAX-aantallen als ook het gemiddeld verbruik per passagier per stretch. Nieuwe beheersing is ontwerpen, erop gericht om zowel de interne prestaties van KLM alsook de prestaties van derden (leveranciers, cateraars en logistiek dienstverleners) te verbeteren.

Een kwantitatieve case study is uitgevoerd om een kwantitatieve onderbouwing te geven voor de op kwalitatieve manier geformuleerde voordelen van het vernieuwde besturingsmodel. Door gebruik te maken van een hypothetisch buitenstation X en verbruiksdata van EUR-vluchten, is aangetoond dat substantiele financiele voordelen behaald kunnen worden door het optimaliseren van voorraadniveaus, het verminderen van veiligheidsvoorraden, het verminderen van non-performance- en reguliere transportkosten en het verminderen van de DOW-impact. Deze besparingen leveren in totaal ruim drie miljoen euro op en demonstreren daarmee het potentieel van het vernieuwde besturingsmodel.

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List of abbreviations

APAC	=	Asian-Pacific Region
BBO	=	Bijzondere Beladings Opdracht (Cabin Load)
CA	=	Cabin Attendant
CCL	=	Business Class
CIM	=	Cabin Inflight Management
CPO	=	Crew Products & Operations
CSA	=	Central- and South America Region
CSR	=	Corporate Social Responsibility
D&D	=	Douane & Distributie (Custom Affairs and Distribution)
DOW	=	Dry Operating Weight
EOQ	=	Economic Order Quantity
EUR	=	European
ICA	=	Intercontinental
IFS	=	Inflight Services
KCS	=	KLM Catering Services
KN	=	Kuehne & Nagel
KPI	=	Key Performance Indicator
KLM	=	Koninklijke Luchtvaart Maatschappij (Royal Dutch Airlines)
L&O	=	Loading & Ordering
MCL	=	Economy Class
MESA	=	Middle East & South Asia Region
MT	=	Management Team
NAD	=	North America Region
NSM	=	Network Supply Management
OS	=	Outstation
PAX	=	Passenger(s)
PM	=	Product Management
SCS	=	Supply Chain Specialist
WH	=	Warehouse

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1 Introduction

KLM Royal Dutch Airlines was founded on October 7th, 1919. Over the years the company has developed into an internationally well-known company and the only airline in the world that still operates under the same name it had when the airline started. Ever since the company merged with Air France in 2004, it is part of the AIR FRANCE KLM Group. Air France KLM is the largest European airline group. Air France and KLM transport over 71 million passengers per year and operate more than 594 aircrafts. On a daily basis, the combination carries out around 2.500 flights in its network with 236 destinations, focused around the main hubs Schiphol in Amsterdam (KLM) and Charles de Gaulle in Paris (Air France). KLM forms the core of the KLM Group. Other members of the KLM Group are the 100% subsidiaries KLM Cityhopper, transavia.com, Martinair and KLM Catering Services B.V[1].

1.1 Mission KLM

Together with Air France, KLM shapes her role as leading player in the European airline industry. In a reliable way and with Dutch pragmatism, 32.000 KLM-employees take care of innovative products for customers and for a safe, efficient and service-oriented operation with an active policy on corporate sustainability. KLM strives for profitable growth that not only contributes to the company's goals, but also to economic and social development. KLM works on creating growth opportunities at Schiphol, gaining access to all markets that can increase the quality of its network and equal relationships for all players in the industry. Also the company strives to find a good balance between the interests of the company and those of the local surroundings[2].

1.2 Vision KLM

KLM wants to be a frontrunner in the airline industry by being smarter than the competition. By the merger with Air France, KLM fulfills a leading role in the worldwide airline industry. KLM wants to be the first choice for its customers; wants to be an attractive employer and wants to be a company that grows in a profitable way for its shareholders. By taking on clever partnerships and taking a pioneering role in selecting new destinations, KLM offers worldwide accessibility through an extensive network. By taking on chances emerging in the market and through technological developments, KLM offers its customers a unique and contemporary product.

[1] http://www.klm.com/corporate/nl/about-klm/profile/index.html, last checked on September 25th, 2012

[2] http://www.klm.com/corporate/nl/about-klm/profile/index.html, last checked on September 25th, 2012

1.3 Context of this research

The above-mentioned mission and vision of KLM are important pillars to use as a foundation for forming policy for day-to-day operations. However, the company struggles with the harsh economic climate. To this end, a strong focus on saving costs runs through all of the company's departments. At the same time, the ambition is to become the best service oriented airline in the world. These two goals might sound contradictory and seem to impose impossible requirements on employees. However, this is not necessarily the case; as will be explained below.

In this context, service is a very broadly defined concept. It covers all the contact with (potential) passengers. Obviously, the direct contact with passengers; more specifically the direct contact with passengers on board and the entire onboard experience form an important part of the service KLM offers its customers. The catering that is offered on board makes an important part of the onboard experience in its turn. This research is aimed at the catering that passengers receive on board and more specifically on the distribution of catering articles that is involved. This research focuses on how the worldwide distribution network of catering articles of KLM can be objectively monitored and how the performance of the network can be increased; the aim is to develop a new control model in order to increase the performance on three predetermined performance categories.

1.4 Structure of this report

This report is divided into six main chapters. This is the last paragraph of the first chapter, being merely an introduction to the rest of the report. The second chapter is aimed to explain the context of airline catering for KLM and the challenges the company faces in doing this. The third chapter focuses on the analysis of the current situation concerning the distribution of catering articles. Based on this analysis, a definite problem statement is formed. The fourth chapter shows the possible solutions to the identified problems, leading to a new control model for the distribution network. The fifth chapter contains a quantitative case study to prove the qualitative concepts of the new control model. The sixth and last chapter contains important conclusions and recommendations for further investigation or required actions.

2 Catering at KLM

The subject of this research concerns the on board catering for passengers of KLM. The department that is responsible for all the aspects concerning the catering of KLM is *Cabin Inflight Management* (CIM), which is a department of the business unit *Inflight Services*. To gain a good understanding of the environment is crucial in order to define a correct and accurate problem statement in the following chapter. This chapter is aimed to explain the different parties involved with the catering, the different steps that need to be followed in order to get the right catering articles on board of the planes and the distribution network that is being laid out over the world with respect to catering articles. In the chapter a non-specific catering product is being followed through all the required steps of the catering process. For each step the involved stakeholders and a description of the step are given.

An important remark is that not all the catering products of KLM are within the scope of this research. The daily fresh foods and drinks are not within the scope of this research. The reason for this will be explained later.

2.1 Why catering?

Ever since the start of the company, KLM has developed into a worldwide operating airline that transports passengers and cargo to 109 destinations in total. These destinations are being divided in 38 European destinations (EUR) and 71 intercontinental destinations (ICA). The ICA-destinations again are being divided in five regions, namely: Africa, Asia-Pacific (APAC), Central & South America (CSA), Middle East & South Asia (MESA) and North America (NAD). KLM's base is Amsterdam Airport Schiphol (AMS).

One of the goals of KLM is to become the airline with the best service in the world. A part of the strategy is that the company wishes to serve all passengers on all flights food, drinks and other catering. The sort and amount of catering products on board depends on the flight duration, time of day of the flight and the destination and thereby varies for different flights. The total load of catering products must be present on both the outbound flight leaving AMS as well as the homebound flight leaving the destination. It also has to comply to very strict requirements in fields of food safety, amounts and marketing, which have been comprised by different KLM departments.

2.2 Step 1 – Product development

2.2.1 Product Management

Based on requirements imposed by the corporate marketing department, Product Management (a sub department of CIM) is responsible for the development of the product portfolio concerning catering products. To put it simply: Product Management (PM) is responsible for determining *what* should be served to the passenger, both for food- as well as for non-food products in order to maximize the customer satisfaction. There are three product groups defined, each with different demands for service levels, sort of products etc.:

1. World Business Class (business class product for ICA-flights)
2. ICA-M (economy class product for ICA-flights)
3. EUR (product for EUR-flights)

Figure 2-1 - WBC meal (disposable and rotable products)

Product Management strictly monitors customer satisfaction, which plays an important role in the change of a product or the introduction of a new product. For instance, meals are being changed regularly in order to offer frequent flyers a varied assortment. Other products, like coffee cups are not changed regularly. PM also organizes special actions, where special products are being placed on board for a limited period of time. Examples are the Dutch Festival (coming up in October and November) and the special Olympic tea and tea-cup designed by the Dutch brand Blond.

The total product portfolio[3] consists of 431 different products, divided in three subcategories: disposables (items that can be used only once), rotables (items that be used multiple times) and equipment (items used to carry catering articles). The sub department Network Supply Management carries out the operational management of the product portfolio.

Figure 2-2 - Blond coffee cup (rotable product)

[3] Last checked on July 4th 2012, source: E. Gerrits.

2.2.2 Network Supply Management

After determining what sort of product should be on board, the next challenge is *how* to place it on board. There is only limited space within an aircraft to fit the catering products, this makes the decision about which amount of which product to place quite complex. At the same time there is a constant struggle to keep the total weight of the catering products as low as possible in order to contribute to fuel savings, which are the major cost drivers for airlines anno 2012.

The NSM sub department *Loading & Ordering* is responsible for determining the optimal placement of the catering products on all flights. The department allocates each specific product to a specific location within the loading equipment. See Figure 2-3 for an example. A very important factor in determining which product should be placed in which trolley(s) is the so called *work methodology* of the crew. This means that the aircraft is divided in sections, each with their own cabin attendant (CA). Each CA needs his/her own supply of catering products to offer the passengers the desired service.

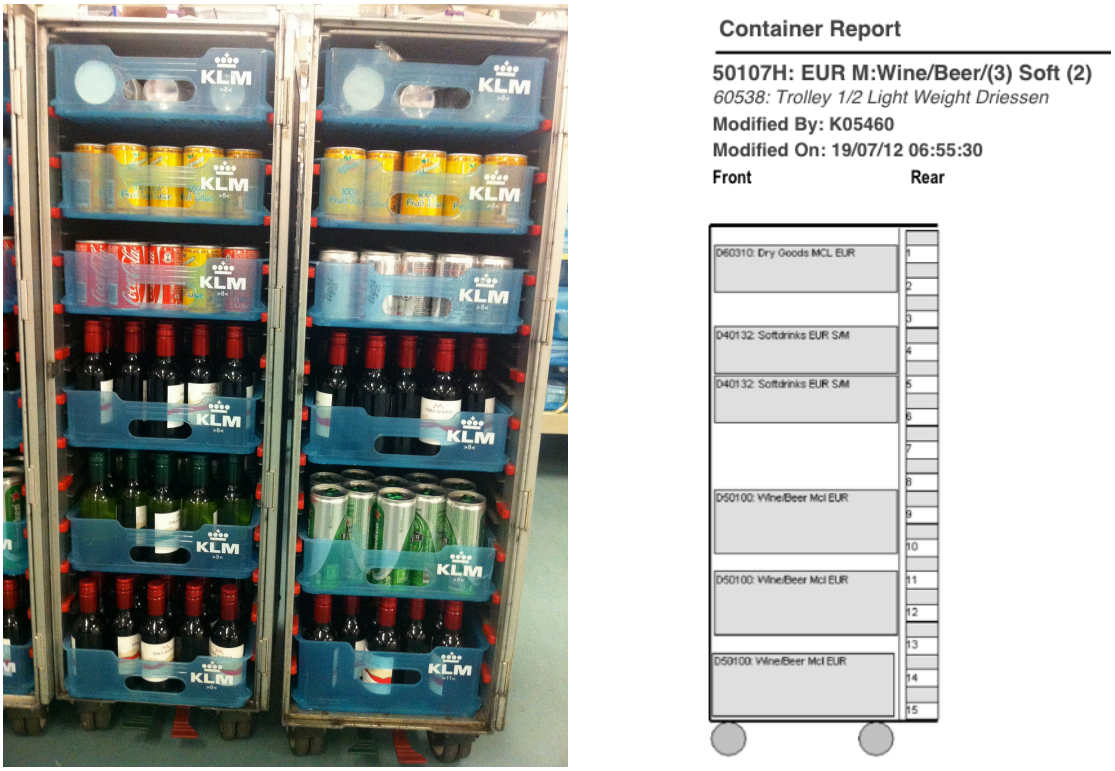

Figure 2-3 - Dry-goods trolley EUR-M (left) and the L&O standard for this trolley (right)

2.3 Step 2 – Product ordering

When product management has finalized the development of a product, the product must be produced and supplied to KLM. Therefore it is necessary to select a supplier. The procurement department is doing this. This is a corporate department, not a part of Inflight Services. This can lead to conflicts of interest, because the buyers of procurement are being assessed on purchasing price, while the lowest purchasing price is not always leading to optimal ordering quantities from a logistical point of view. Currently CIM deals with 106 different suppliers[4].

After the selection of the supplier, the NSM planning department is responsible for the operational execution of ordering and controlling the inventory of a product. They use the IT-system of SAP to do their work. The planning department is divided in two sections: the central planning and the area planning. The latter will be explained in section 2.8, the first is responsible for the ordering of products with the suppliers.

Based on actual inventory levels and the selected control-algorithm, SAP gives a ordering advice. The planners can modify this when necessary and then place the order at the given supplier. This is done by either sending an automated e-mail through SAP or by sending a self-written e-mail by one of the planners. One remarkable notion is that the supplier is not absolutely required to send an order confirmation, so the planner cannot be 100% sure whether a supplier has actually received an order and starts working on it. A good thing is that most suppliers do send an order confirmation as a standard procedure though.

2.4 Step 3 – Product delivery and storage

When an order is placed, SAP automatically creates a delivery date based on the agreed lead-time of an order with the supplier. The supplier handles the order and is given a specific timeslot of one hour on the delivery date to show up at the warehouse at Schiphol Noord where the products are being stored. The warehousing is done by KLM Catering Services B.V. (KCS), a 100% subsidiary of KLM. In this report, the part of KCS that is responsible for the warehousing activities is being referred to as KCS Warehouse.

Figure 2-4 - Suppliers docking at KCS Warehouse

[4] Last checked on July 4th 2012, source: E. Gerrits. See Appendix D for a detailed overview.

The driver must call in at the warehouse, after which his delivery is being checked and then registered in SAP. When the shipment is registered, the next step is to put it away in the preferred storage location. This location is provided by SAP, the system automatically calculates the most efficient location to store the delivered goods. An important notice is that only the non-fresh and non-food products are being delivered to KCS Warehouse, the fresh products needed for meals are directly delivered to KCS Centrum (see *Step 4 – Product loading*)

By registering deliveries in SAP, the central planning department sees that inventory levels are being updated and they also see where the delivery should be placed in the warehouse. However, it happens that the delivered products are not put away at the suggested storage location, but somewhere else. This can cause a lot of ambiguity on the location of the products, which is not preferable for a smooth operation. It is obviously very important that the digital values that SAP uses to do its calculations are the same as the actual values of products in the warehouse.

2.5 Step 4 – Product loading

The next step in the process is loading the equipment of the flight with the required products. This is being carried out bij KCS Centrum at Schiphol Centrum. At this location a working stock is being kept to make sure that the production of loaded equipment is able to be continued at all time. This means that the products need to be transported from KCS Warehouse to KCS Centrum. This is done by truck all day long.

At KCS Centrum the entire catering load for each KLM flight that leaves Schiphol is being produced. There are different departments that each make different parts of the entire load. For instance, for both the ICA and the EUR flights there is a *food preparation department* and a *non-food and beverage department*. All the trolleys and boxes are being loaded by following the standards that have been prepared by L&O under *Step 1*. It is important that these standards are being followed strictly, because otherwise the cabin attendants will not know where to find products.

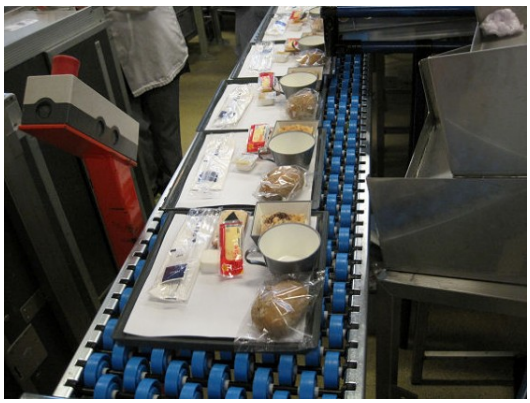

Figure 2-5 - ICA-M food assembly line

Figure 2-6 - Bringing the catering load on board of the aircraft

When all the trolleys and boxes for a flight have been prepared, they are assembled together at the platform side and loaded into the *schaarwagens*, the trucks that will drive to the aircrafts and place the loaded equipment into the right places in the galleys on board. KCS Centrum operates between 70 and 80[5] schaarwagens at any given time, using a dense schedule in order to unload all the catering equipment from incoming flights and loading all leaving flights.

2.6 Step 5 – The flight

Step 5 is obviously the most important step in the process. All the efforts in the steps before or after this one are being carried out to make sure that the passengers will get the desired catering products on their flight. After a successful takeoff the cabin attendants use the service schedule that has been defined by Product Management to serve the passengers the different rounds of service. The layout of the service schedule depends on the length of the flight and the time of day at which the flight is being carried out.

Figure 2-7 - KLM stewardess serving food and drinks on board

KLM strives to become the best service oriented airline in the world, which means that the passenger satisfaction is very important. The evaluation of the catering products that passengers get offered during a flight forms an important factor in the overall satisfaction rate and so it is very important to have the right products on board. But at the same time, KLM wishes to maximize its profit on a flight by making sure that not too many products are put on board. Therefore, knowledge of the on board consumption of passengers is important.

If KLM is able to predict the consumption of catering products on a specific flight, the company will be able to load and serve efficiently. Until now, only the *Inflight Report* (IFR) written by the purser (the leading cabin attendant on a flight) gives some insight in shortages of products. But this is a very limited system, which only shows excessive usage. Nothing can be said about potential over supply on board, because no reports are written about having too much products on board.

[5] Source: J. van Leeuwen, distribution officer KCS Centrum.

In order to increase the insight in the on board consumption and to gain knowledge about potential weight- and cost savings on flights, a good 200 flights were isolated and all the unused catering products were counted in the March 2012. This was done only on EUR-flights. It was remarkable to see how many unused products, especially drinks, returned. This proved that major cost savings can be achieved by loading more efficiently. The results were digitally processed; an example of the usage of red wine in the economy class on EUR-flights can be seen in Figure 2-8.

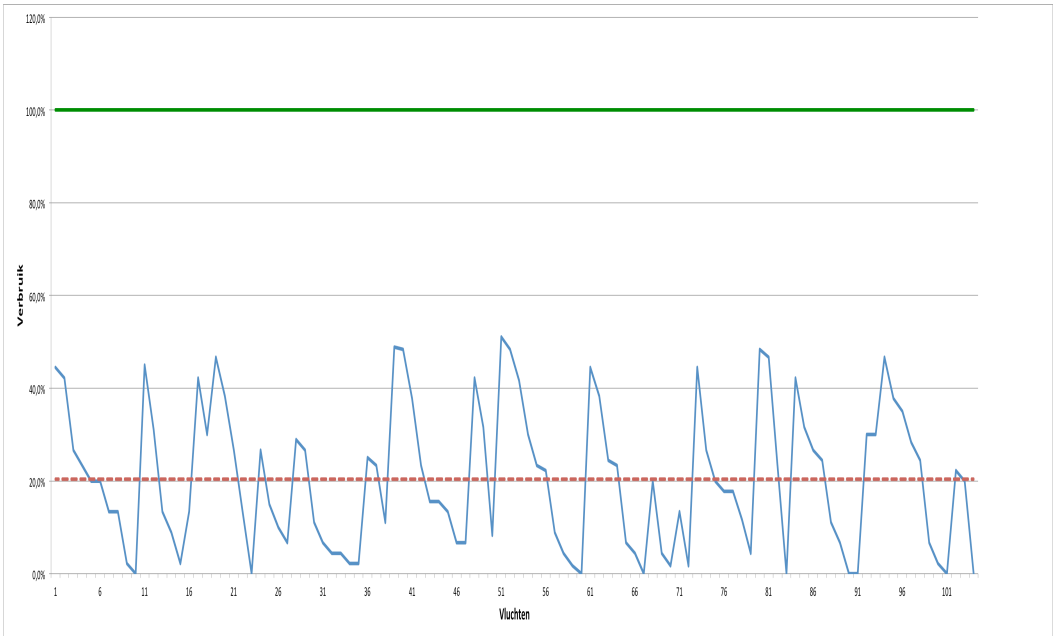

Figure 2-8 - Consumption of red wine in the EUR economy class

2.7 Step 6 – Product unloading

When the flight has landed and all the passengers have safely left the aircraft, all the catering equipment is taken off board again and is transported to the *ROA* (Retouren Ontvangst & Afval) at KCS Centrum. The trolleys and boxes are taken out of the schaarwagens and each placed in their designated areas for further processing. The products can be categorized in three different categories:

1. Waste products;
2. Products for regeneration;
3. Products for cleaning.

Waste products are the product carriers of used consumables and leftover food and drinks. These products are being separated from the rest; most of it is already in the waste trolleys. The different sorts of waste are separated again and each processed in its own way. Some of the waste is burned; some of it is collected by Van Gansewinkel and is recycled.

Products for regeneration are unused products that can be loaded again into another trolley for another flight. Products for regeneration are usually consumable products that have not been used during a flight, for instance unused cans of soda, bottles of wine or tubes of sugar and coffee creamer.

Products for cleaning are used rotable products that can be used again after cleaning them. This cleaning is partially done by KCS itself, mainly the chinaware used in the business class. Other articles that need cleaning, such as blankets and linen napkins are being transported to Lamme Textielbeheer. Lamme has a state-of-the art industrial cleaning facility at Schiphol Noord where the different textile products are being cleaned.

After the completion of this step, the process of getting a product on board to serve the passenger including the handling after the flight is completed. Steps 2 til 6 will repeat until the particular product is taken out of the product portfolio.

2.8 EUR versus ICA

The six steps that were explained above, explain the general process of a catering product for a EUR-flight. The first step is always the same, whether the product is developed for a EUR- or an ICA-flight. However, there are some important differences or required additions to the explanations above for steps 2, 3, 4 and 6 on ICA-flights.

For EUR-flights, with a considerably shorter flight time than ICA-flights, it is possible to load the catering equipment for both the outbound and the homebound flight at Schiphol. This is called *galley-galley catering*. For ICA-flights, however, this is not possible because there is not enough storage space in the aircraft's galleys and the freshness of the food will not be sufficient either. This means that KCS Centrum is the dedicated caterer for the outbound ICA flights, but in order to have the catering on the homebound flight as well, KLM has contracts with caterers at its destinations.

2.8.1 Outstations

KLM does not have a contract with a caterer at every destination the airline flies to. The destinations at which KLM has a caterer are called *outstations*. On the grand total of 71 ICA destinations there are 58 destinations designated as outstation and the other 13 are 'simply' destinations.

The catering handling of a flight is now separated in the handling of the outbound flight by KCS at Schiphol and the handling of the homebound flight by the caterer at the outstation. KCS loads the outbound flight, the caterer does the unloading of the outbound flight, the caterer loads the homebound flight and KCS does the unloading of the homebound flight.

Obviously, the caterer needs its own supply of KLM catering products in order to be able to load the products onto the homebound flight. KLM has chosen to organize the distribution of these products by having a central warehouse (KCS Warehouse) where all their suppliers deliver all their catering products and then distributing the specific products that a caterer needs to every outstation. For the distribution three different transport modalities can be used: (1) sea freight, (2) air freight or (3) pantry-outfits. A schematic overview of the distribution network of NSM is depicted in Figure 2-9.

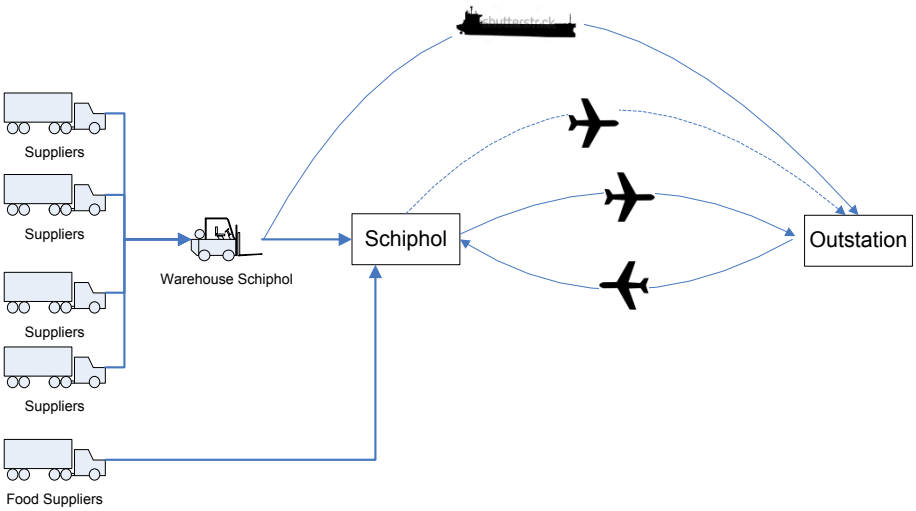

Figure 2-9 - Distribution network of NSM

2.8.1.1 Sea freight

This is the preferred transport modality for the distribution of catering products by NSM. The reason for this is that sea freight is a lot cheaper than the other two modalities. A comparison shows that for KLM transporting sea freight costs on average € 0,01 per ton-km versus € 0,10 per ton-km for transporting airfreight[6]. Most outstations are supplied by using sea freight through a logistics service provider, Kuehne & Nagel. The total number of outstations that are supplied by sea freight is 42; a schematic overview is presented in **Table 2-1**.

2.8.1.2 Airfreight

There are a number of reasons why sea freight is not possible and another transport modality has to be chosen. Then airfreight is next in line. These reasons are:

- Customs problems at the destination port;
- The outstation is not (or very hard) reachable by sea;
- The volume of products to send to a outstation is so low, that it is impossible to fill a sea container up to an acceptable level;
- Emergency shipments that require a shorter lead-time than the shortest possible lead-time that can be achieved by sea freight.

Only in these cases airfreight is preferred over sea freight, which is executed by another logistics service provider (Blue Crown). The total number of outstations that are being supplied with airfreight is 19; a schematic overview is depicted in **Table 2-2** on page 14.

[6] Calculation based on data supplied by R. Hoffschlag of the Custom Affairs & Distribution Department.

Table 2-1 - Overview outstations supplied with sea freight

Africa	APAC	CSA	MESA	NAD
Accra (ACC)	Bangkok (BKK)	Bonaire (BON)	*No seastations*	Atlanta (ATL)
Capetown (CPT)	Chengdu (CTU)	Curaçao (CUR)		Dallas (DFW)
Dar es Salaam (DAR)	Delhi (DEL)	Buenos Aires (EZE)		Washington (IAD)
Johannesburg (JNB)	Hangzhou (HGH)	Rio de Janeiro (GIG)		Houston (IAH)
Luanda (LND)	Hongkong (HKG)	Havanna (HAV)		New York (JFK)
Lagos (LOS)	Seoul (ICN)	Lima (LIM)		Los Angeles (LAX)
Nairobi (NBO)	Osaka (KIX)	Paramaribo (PBM)		Chicago (ORD)
	Kuala Lumpur (KUL)	Panama City (PTY)		San Francisco (SFO)
	Manila (MNL)			Montreal (YUL)
	Tokyo (NRT)			Vancouver (YVR)
	Beijing (PEK)			Calgary (YYC)
	Shanghai (PVG)			Toronto (YYZ)
	Singapore (SIN)			
	Taipei (TPE)			
	Xiamen (XMN)			

2.8.1.3 *Pantry outfit*

This transport modality is only used as a way to repair emergencies. When there is a sudden need for a small number of important articles at an outstation, for example a product without which the flight is not allowed to depart, a small number of products can be transported to the outstation on the outbound flight. There is designated room for these so-called pantry outfits, or BBO's[7], on every flight. Because of the highly disturbing character with respect to the normal distribution process, the use of pantry outfits minimized. An overview of the number of BBO's in 2012 and their reasons is given in Figure 2-10.

[7] BBO is short for Bijzondere Beladings Opdracht, Dutch for Special Load Assignment.

Table 2-2 - Overview outstations supplied with air freight

Africa	APAC	CSA	MESA	NAD
Addis Abeba (ADD)	Jakarta (CGK)	Aruba (AUA)	Almaty (ALA)	Mexico City (MEX)
Cairo (CAI)		Sao Paulo (GRU)	Abu Dhabi (AUH)	
Entebbe (EBB)		Guayaquil (GYE)	Bahrain (BAH)	
Lusaka (LUN)		Quito (UIO)	Damman (DMM)	
			Dubai (DXB)	
			Kuwait (KWI)	
			Muscat (MCT)	

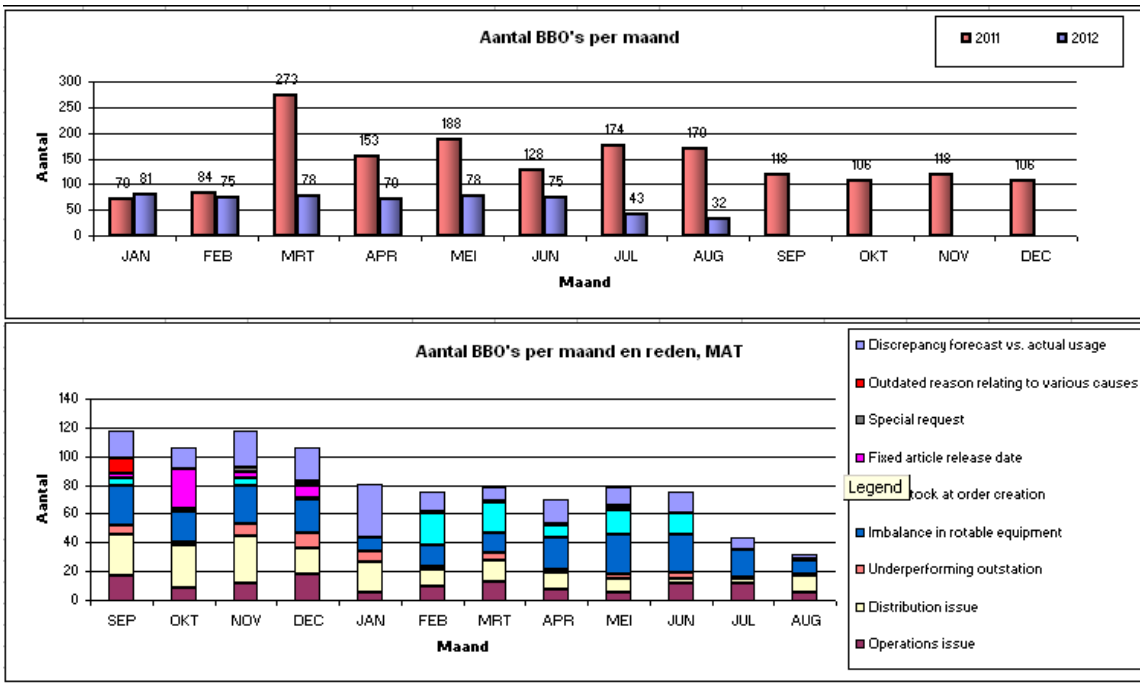

Figure 2-10 - Overview BBO's

2.8.1.4 Inventory management at outstation

In order for KLM to be able to provide the passengers with the desired service, it is important to have enough inventory at the outstations. At the same time, it is desirable not to have too much inventory. Because the replenishment of the inventory of the outstation originates from the central warehouse at Schiphol Noord and sea freight (with its long lead times) is the desired transport modality, it is very important to have accurate digital data about the current stock values of the different products as well as knowledge about the predicted consumption of the articles.

KLM uses the following procedure in replenishing the inventory at outstations. The *area planning* is responsible for monitoring the inventory levels in SAP. Based on a forecast the area planners see the need for articles at outstations. A sea shipment is sent to each outstation every two or four weeks, depending on the lead-time to the outstation. On average, the lead-time between leaving the warehouse and arrival at the outstation is 50 days. Due to disturbances in transportation, unclear lead-times and no accurate knowledge about consumption, the current safety stock levels at the outstations are three weeks of inventory.

Based on the MRP, the area planning makes a purchase requisition in SAP including the possible shipping date. At KCS Warehouse, workers pick the order, prepare the shipment and pass it over to Kuehne & Nagel. The department of *Douane & Distributie* (Customs & Distribution) are responsible for the correct custom papers for the shipment as long as it is in The Netherlands. Outside Dutch borders, filing the right custom papers is the responsibility of Kuehne & Nagel.

When the shipment arrives at the outstation, the caterer must enter it in SAP. This way, the area planners can check whether the shipment is correctly delivered. The caterer is advised to stow the shipment in a small warehouse and have a low level of working stock at the location where the catering load is being assembled. The area planning is only interested in the inventory level in the warehouse, based on these data SAP runs the MRP's. However, it is not required to have a warehouse and a working stock, therefore some caterers directly assemble the flight from the warehouse (their working stock is the entire stock). When a product is removed from the warehouse, the caterer is obliged to *issue* this in SAP. Also, when a product is no longer fit for use, for example because a pallet with cans of soda fell, the caterer must issue this in SAP as scrap.

Once a month, the caterer is obliged to physically count the current stock and send the data to the area planning. The counted inventory levels are being compared to the SAP-values. Discrepancies can be acted upon, resulting in sending new stock earlier or later. This is also a way of checking whether the caterer's issuing is qualitatively acceptable.

What is remarkable is the freedom the caterer has with respect to issuing in SAP and physically counting inventory levels. The caterer can decide when to issue. This means that one caterer does this at the end of the month, just before their monthly count is scheduled. The other collects issues during the day and digitally transfers them at the end of the day. The caterers also follow the rules loosely concerning the monthly counting. There are caterers that count twice a month (without a request for doing this from the area planning), other caterers are very resistant against counting meaning that the planners really have to push them to do it regularly. The area planning would like to have more counts during a month, but there is a risk that the caterer will start to charge more man-hours meaning the costs will rise. This lack of homogeneity in the working methods of the caterers is due to the fact that KLM does not impose strict requirements, but they give caterers recommendations. Also, the caterers have declared that they do not always understand what KLM wants from them concerning the inventory management at the outstation.

2.9 Problem statement KLM

The KLM department Network Supply Management indicated that they do not have objective process parameters defined, therefore making it impossible to evaluate the performance of the operational planning in an objective way. In order to become a more professional organization, the insight in important process parameters is very important.

The original assignment is to evaluate the distribution network and formulate a new control model that enables NSM to measure the performance and gives them possibilities to influence the performance where and when this is necessary. The goal is to work towards higher inventory reliability and lower costs in the supply chain.

3 Analysis of the catering distribution network

3.1 Stratum 1 – KLM Passenger Business

Within KLM three business units are defined: (1) Passenger Business, (2) Cargo and (3) Engineering & Maintenance. For this research the focus lies on the catering service KLM offers her passengers. The activities concerning the catering are all part of the business unit Passenger Business. The other two business units are left outside the scope of this thesis. The goal of KLM Passenger Business is to transport passengers with a need for air transportation from destination A to destination B, while providing the passengers the best service. A schematic overview for this first stratum is given in Figure 3-1. The basic elements for an analysis of KLM Passenger Business can be found in Appendix B.

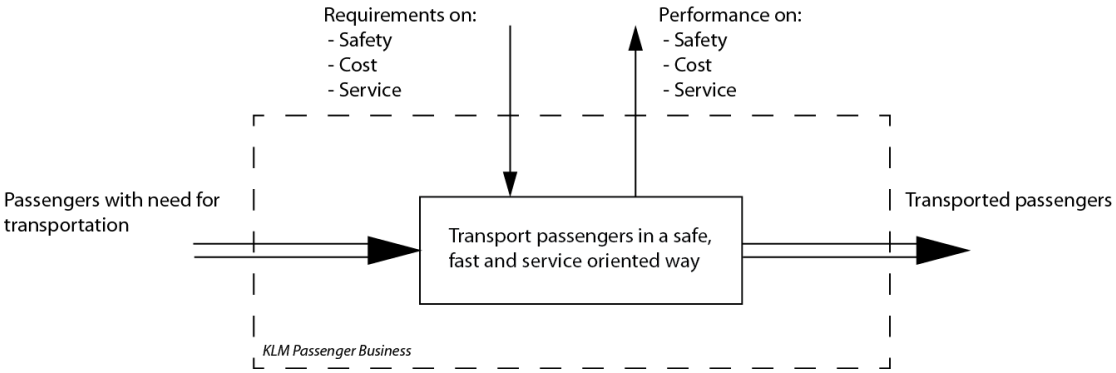

Figure 3-1 – Stratum 1 KLM Passenger business

Due to the financial crisis that started in 2008, the current euro-crisis and fierce competition, the airline industry finds itself in a very rough period in its existence. KLM is no exception on this subject; the company is, as part of the AIR-FRANCE KLM Group, struggling to make a profit. Therefore it is, now more than ever, important to have a strong own identity as an airline. KLM has chosen for a position in the top-segment of the industry, as a full service carrier. Still the company feels in the European market the pressure on ticket prices and possible loss of sales to the low cost carriers. A unique selling point of KLM is that it offers its long-haul passengers excellent transfer possibilities towards destinations al over Europe (or the other way around: EUR-flights as *feeders* to ICA-flights).

3.2 Stratum 2 – KLM Passenger Business

In order to strengthen its position, KLM has set a goal to become the best service oriented airline in the world. Before this is being described in more detail, it is important to zoom in on the black box in Figure 3-1 to show the three different main functions that are concerned with the successful execution of transporting passengers in a safe, fast and service-oriented way.

These functions are (1) process the administrative transport request, (2) the physical transportation of passengers and (3) the allocation of the right resources to be able to execute the air transportation. This is schematically depicted in Figure 3-2.

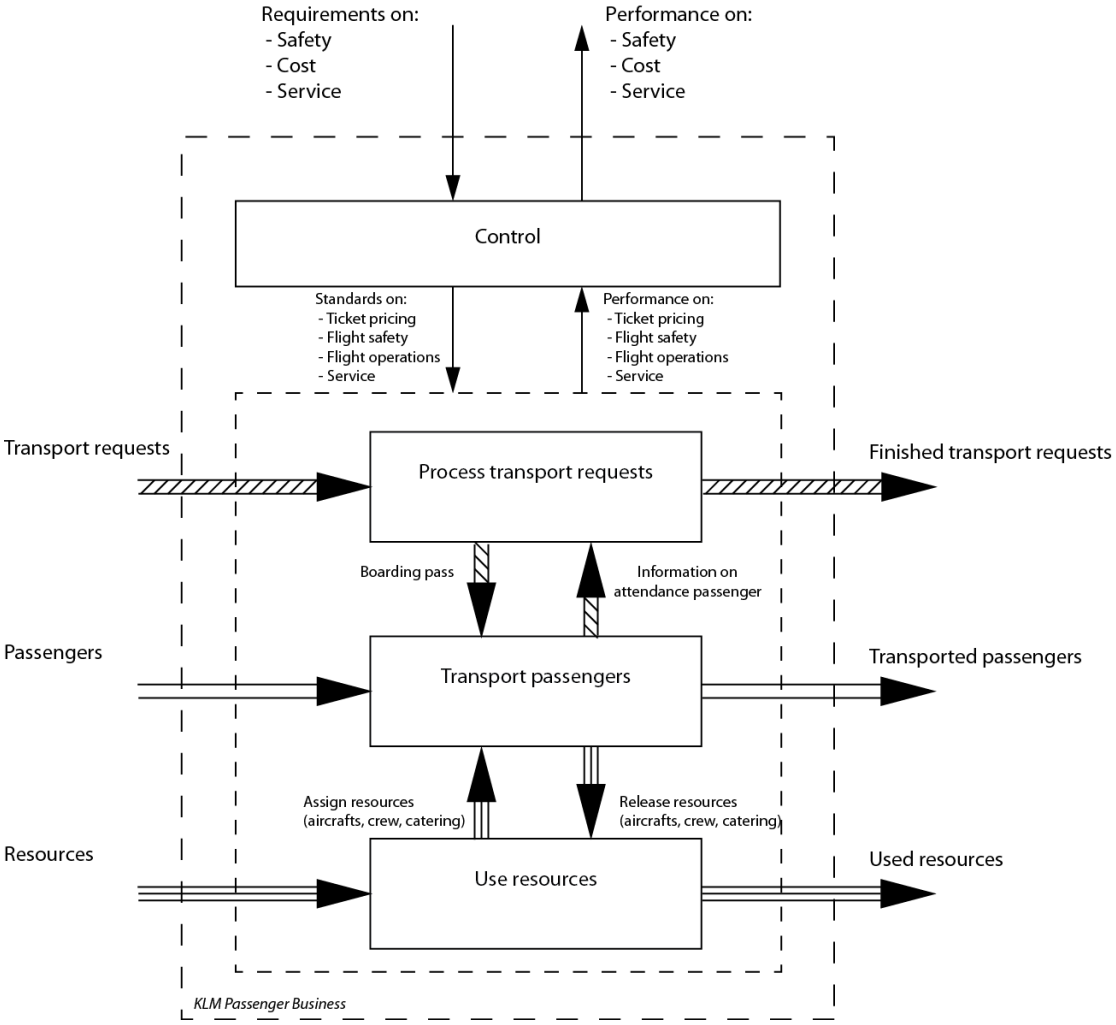

Figure 3-2 – Stratum 2 KLM Passenger Business

For each of the functions a further explanation will be given below.

3.2.1 Process transport requests

The potential passengers indicate that they have a need for transportation by air. They can find out whether KLM offers a connection to their desired destination. Then, they are able to purchase a ticket on a specific flight through three different sales channels: (1) through the online ticketshop of KLM or another internet platform like Cheaptickets, (2) by phone at the KLM ticketline or (3) at the sales offices. The passengers receive confirmation of their purchase, including all the necessary information needed concerning checking in, receiving boarding pass etc. The boarding pass is the final 'receipt' in order to be physically allowed to board the specific flight. The financial processing of the transport request is also allocated to this function.

3.2.2 *Transport passengers*

This functions concerns the physical transport of the passengers from destination A to destination B. KLM wishes to differentiate itself from other airlines in the service they provide during the flight and the way the passengers are treated by the crew (pilots and cabin crew).

3.2.3 *Use resources*

For a successful execution of transporting passengers by air, numerous resources are needed. For now, the focus lies on three different aspects: (1) the aircraft assigned to a specific flight, (2) the crew assigned to a specific flight and (3) the catering load according to the service schedule of a specific flight.

The aircraft assigned to a specific flight must be in absolute top condition and therefore has to comply to strict regulations concerning flight safety. On this level the operational preparation of the plane is part of the assignment of the aircraft. Functions regarding this operational preparation are performing safety checks, fueling the aircraft with kerosene, filling the water tanks, preparing the interior etc.

The crew assigned to a specific flight is divided into the flight crew (pilots) and the cabin crew. The latter is led by the (senior) purser, depending on whether it is an EUR-flight or an ICA-flight. The cabin crew provides the inflight service to the passengers, which includes a range of tasks varying from providing safety instructions, to serving food and drinks.

The third category of resources needed for the successful execution of KLM's passenger air transportation is the catering load that is used on board the aircraft. The catering load enables the crew to provide the inflight service to the passengers. Based on the service schedule that has been assigned to a specific flight, the total catering load, including a detailed description of the amounts and location of all catering articles, is allocated by the NSM department Loading & Ordering (see previous chapter).

3.2.4 *Best service oriented airline in the world*

As previously stated, one of the goals KLM has defined for the future is to become the best service oriented airline in the world. Service oriented in this case is narrowed to the inflight service. This poses major demands on both the quality of service the crew offers the passengers, as well as major demands on the catering load for every flight. In other words: this corporate goal can be translated into requirements for both the crew as well as the catering product (the portfolio of articles) that KLM wishes to have on board.

The subject of this thesis concerns the worldwide distribution of catering articles. To gain more understanding of the functions concerned with the distribution network, there will be

zoomed in on the *use resources* function, focusing on the catering load. Therefore, the assignment of aircrafts and crew will be left outside the scope of the next stratum.

3.3 Stratum 3 – Distribution of catering articles

The department Product Management, as described in the previous chapter, develops the total product portfolio concerning catering products based on requirements they receive from the corporate marketing department. The development phase and its influence on the distribution of articles will be described in section 3.6. This section concerns the execution of the process of getting the right products in the right amounts on board of the right flights, both outbound and homebound.

The outbound flight is prepared at KCS Centrum; the homebound flight is prepared at the outstations. This means that on both locations, the right amounts of products must be present. KCS Warehouse, the central warehouse, supplies both locations. A schematic overview of the distribution network around one couple of a outbound and a homebound flight are depicted in Figure 3-3 (on page 21).

3.3.1 Explanation of functions

The entire physical distribution network around a flight couple (outbound & homebound) is basically a repetition of a single process, because both the execution of both flights follows the same procedure. There are some differences though and these will be explained when necessary. The explanation of the functions will be done by reasoning back from the functions with direct contact with the passenger upstream towards the beginning of the process.

3.3.1.1 Consumption during flight

Passengers on board the flight have, depending on whether they fly business- or economy class, a choice between a certain variety of products. Each flight is assigned a specific service schedule, which dictates the number and types of catering services that are offered during the flight. The ideal case would be that all catering articles are being used during the flight without disappointing passengers; so all consumables should be consumed and all rotables used. If this were the case, the efficiency of the catering load would be at its best.

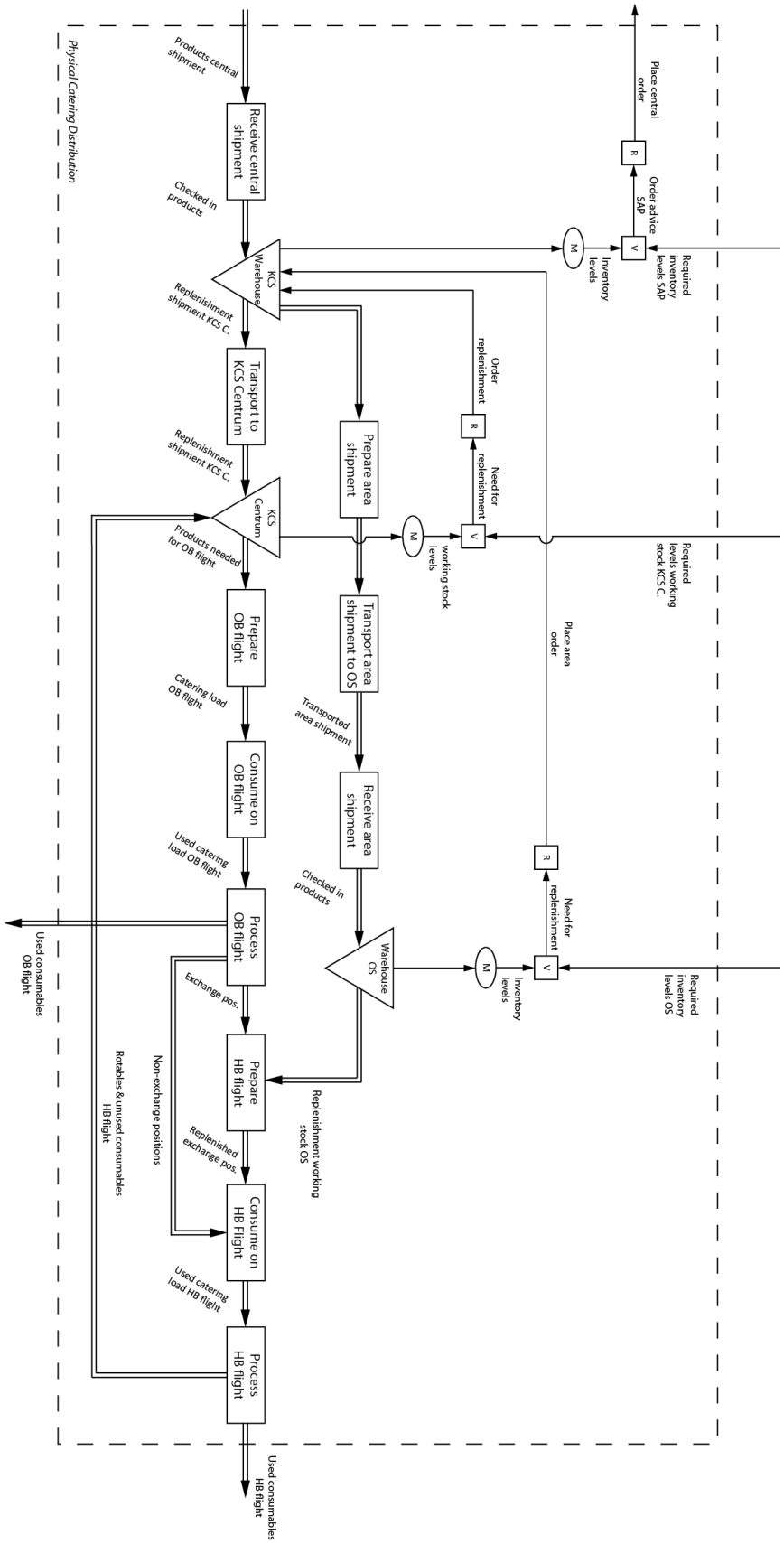

Figure 3-3 - Stratum 3 Physical Catering Distribution.

However, knowledge about the on board consumption is not present. The only mechanism to receive feedback about the on board consumption are the Inflight Reports (IFR's) written by the purser. Here, the crew can indicate that there were not enough articles on board of a specific product. However, this feedback information has a lot of ambiguity to it, because it is used in different ways by different pursers. Still, when a lot of IFR's come up concerning a certain product there is a good chance that an alteration of the catering load will be initiated. Note that the feedback loop of IFR's is intentionally left out of this model, because the goal for this specific model is to depict the physical distribution as clear as possible.

3.3.1.2 *Prepare flight (OB or HB)*

The total catering load for both the outbound and the homebound flight are being prepared by caterers. The outbound flight is prepared at KCS Centrum, the homebound flight by the local caterer at the outstation. Both caterers use the standards[8] defined by Loading & Ordering. There is a small difference between the work that KCS Centrum does and the local caterer's work. Some trolley positions for ICA-flights are loaded for both the outbound and the homebound flight. There are strict rules concerning the layout of the trolleys and the presentation and quality of the food and beverages; checking whether the caterers comply to the rules is being checked by the cabin crew (mostly by the purser) and third-party regulation offices like Medina.

3.3.1.3 *Operational warehousing (KCS Centrum or Outstation)*

In order to assure that the preparation of the catering load can continue, it is important to have the right amount of products present at the work floor. Therefore all the caterers, including KCS Centrum, need to have a working stock of products at the work floor. For all locations there has been determined a minimum stock level that is required and this parameter is used as a guideline for ordering replenishments.

Because KCS Centrum is responsible for the assembly of catering loads for all KLM-flights, maintaining the right working stock levels differs from the way this is done at outstations, where the local caterer is responsible for only one, sometimes two, KLM-flights per day. For KCS Centrum there are daily replenishments from the central warehouse, but at outstations this is done only once every two, four or six weeks.

[8] See the previous chapter for an example

3.3.1.4 Process flight (OB or HB)

After the flight has safely landed and the passengers have disembarked, the remainder of the catering load is being taken off the aircraft by the caterer. Depending on whether the flight was the outbound or homebound stretch, a part of or all of the trolleys and boxes are taken off board. As already mentioned in the description of the function *prepare flight*, there are certain positions that only KCS Centrum loads. These positions are called *non-exchange positions* and the local caterer at the outstation does not take these from the aircraft. An example of a non-exchange position is the trolley where the liquors are stored. The non-exchange positions remain on board for further use on the homebound flight.

The processing of the trolleys that are taken from the aircraft is the same for the outbound and homebound flight. They are separated in three main categories: (1) used consumables, (2) unused consumables and (3) rotables. These different flows of products are separated and each processed in their own way. Used consumables are waste products and treated as such, the unused consumables are being regenerated (used again) and the rotables are being cleaned and then used again.

3.3.1.5 Transport to operational warehouses

It is important to differentiate between transport to the operational warehouse at KCS Centrum and the transport to the operational warehouses at the outstations. The first is carried out multiple times a day by truck from the KCS Warehouse to KCS Centrum. This is done based on daily stockcounts and replenishment towards a designated stock level.

The second is done based on orders placed by area planners. The regularly executed stockcounts at the outstation are compared with the forecasted usage in the designated period. Based on this a need for products is generated and the area planner will create the order. The order is picked by KCS Warehouse and transported in three possible ways: (1) by sea-transport, (2) by air-transport or (3) by cabin load on board of a KLM flight. Both sea- and air-transport shipments are executed by logistic service providers.

3.3.1.6 Central warehousing (KCS Warehouse)

The central warehousing at Schiphol Noord is the responsibility of KCS Warehouse. Here all the suppliers of catering products[9] deliver their shipments. The products are stored until a request for them originates at either KCS Centrum or an order placed by area planners. All the products are replenished when their stock level drops below a certain value. This is the

[9] Important note: this concerns all the catering products in the portfolio of NSM.

responsibility of the central planning department of NSM. They place the orders at the suppliers and monitor the stock values.

3.3.2 Important process parameters and their evaluation

First, the important performance indicators as defined by KLM will be explained. Then the main process criteria are being compared with these performance indicators.

The overall KLM goal to become the best service oriented airline in the world can be translated to goals and performance indicators for NSM. Ultimately the goal with catering on board is to make the passenger happy. In order to do so, KLM must know what it is that passengers want for catering and in which quantities and volumes passengers are using articles. Therefore knowledge about consumption patterns must be developed. Based on this, operational service levels can be assigned to each product or product group.

Because of the limited storage room on board of the aircrafts, there is a need to distribute catering articles to the outstations. This distribution network is also contributing to satisfying the passengers with respect to the catering on board of the flights. Therefore, the service levels that can be defined based on consumption patterns and operational agreements (trade-offs must be made with respect to how far KLM can go to satisfy the need for a specific product) are used as normative settings to come up with inventory levels at outstations and the central warehouse.

NSM has translated the goal of satisfying customers and their own role of distributing catering articles into three main performance indicators for the global distribution of catering articles. These indicators are:

- Reliability of inventories
- Quality
- Costs

The performance of the system should be measured and compared with standards that are defined. Also, when dissatisfactory values are measured, there should be means to control and adjust the system in order to achieve satisfactory results.

According to Bikker[10] there are six main process criteria that can be used to evaluate the performance of a system. These criteria will be described in relation to the physical distribution of KLM and there will be concluded what the importance is with respect to KLM's catering distribution network.

[10] H. Bikker, *Analyse en Ontwerp van de Produktie-Organisatie*, nr. 181, pp. 4.

3.3.2.1 Effectivity

The theoretical effectivity is defined by In 't Veld[11] as the ratio between the expected results and the desired results of an action, or stated in formula form:

$$effectivity_{theoretical} = \frac{R_{expected}}{R_{desired}}$$

Effectivity is therefore a way of expressing whether a system is 'doing' the right things. For the catering distribution of KLM the effectivity reflects how well KLM is performing on getting the right amounts of catering products at the required locations for loading the aircrafts.

Important parameters that influence the overall effectivity of the system are:

- *Quality of deliveries of suppliers* (are the right amounts being delivered), for this parameter often *service levels* are agreed upon by the buyer and the suppliers.
- *Quality of deliveries to the outstations*, for this parameter service levels should be defined as well.
- *Quality of loading the trolleys and boxes*

Effectivity is therefore an important parameter in order to evaluate the *availability of inventories*, both at the central warehouse as well as at the caterers (KCS Centrum and local caterers at outstations).

3.3.2.2 Flexibility

Flexibility is defined by Bikker as the ability to quickly react to sudden changes. This definition needs explanation on what is defined as a *change* and what is meant with *quickly react*. To this end, three different sorts of flexibility are defined:

- *Product flexibility;* this is the ability to quickly react in order to deal with changing demand for different products and product assemblies
- *Process flexibility;* this is the ability to react to changes in following different process steps.
- *Organizational flexibility;* this is the ability to quickly react to requirements that make small-scale changes to the organizational layout necessary

For the distribution of catering articles, only the *product-* and *process flexibility* are important. Product flexibility because changes in the product portfolio should be processed smoothly, without having to make a lot of repair costs. Also because different flights might need different products, therefore different outstations require different parts of the product portfolio.

[11] J in 't Veld, *Analyse van Organisatieproblemen*, pp. 327.

Process flexibility is important because the system must be able to quickly choose between following different process steps in order to get the required articles at the right locations (this flexibility mainly concerns the choices that are being made with respect to transport modalities).

3.3.2.3 Productivity

Productivity is defined by Bikker and In 't Veld as the ratio between results and the sacrifices that needed to be made in order to achieve the results, or stated in formula form:

$$productivity = \frac{results}{sacrifices} = \frac{R}{S}$$

In the context of the distribution of catering articles it is important to make a distinction between sacrifices concerning *costs* and *time*. Therefore, it is helpful to define two different productivities:

- $P_{costs} = \frac{results}{costs} = \frac{R}{C}$
- $P_{lead-time} = \frac{results}{lead\text{-}time} = \frac{R}{L}$

Here, lead-time is defined as the time that is needed between the notice of a required action and the moment that the action is completed.

So $P_{lead\text{-}time}$ is an important parameter to evaluate the *availability of inventories* and P_{costs} is an important parameter to evaluate the *costs* that are concerned with the distribution of catering articles.

3.3.2.4 Control of the system

Controlling a system can only be done when the aspects that need to be controlled are defined. Also, specific requirements to each of these aspects must be defined. These requirements are defined based on the policy and organization of the primary transformation process. Based on the policy, the standards for effectivity, productivity and flexibility are defined. Based on that, the aspects that need control can be identified. Possible aspects are *product quality*, *delivery times*, *lead-times* and *inventory levels*.

3.3.2.5 Quality of work

The quality of work mainly concerns the content of the work. It is about the functions and the function-content of individual employees and groups of those. The way that functions are distributed over employees is essential for the joy and fulfillment that the employees get out

of their job. Do the employees have the notion of getting challenged in their function? And what motivates them in their job? Important questions that, when answered and processed into interesting jobs, can add to the overall productivity of the employees.

3.3.2.6 *Innovativeness*

In the context of systems theory, incorporating innovativeness means that a sub system must be able to evaluate certain aspects and be able to initiate improvements. This means that the introduction of new initiatives can be executed bottom-up. For the distribution of catering articles the innovativeness is quite high, the planning department for instance has the possibility to incorporate changes in their process according to their own analysis and measurements.

3.3.2.7 *Translation of process parameters into performance indicators*

In the context of NSM, the first three process parameters effectivity, flexibility and productivity can be translated into measurable performance indicators to be used in the redesigned control model for the distribution network. The effectivity is concerned with having the right products in the right place, the flexibility has to do with this as well, but also with the ability to react to disturbances in the normal process and the productivity is concerned with the costs that are involved in the distribution network.

These parameters are translated into measurable *key performance indicators* (KPI's) that should be used to be able to assess the performance of the system on these important process parameters. There are a total of 25 KPI's defined, an overview of which is given in Table 3-1 on the next page. These KPI's are used to fill in the overall performance categories defined by KLM (reliability of inventories, quality and costs). The KPI's are clustered in the performance categories that were defined by KLM and these categories will be used to address the evaluation of the process parameters effectivity, flexilibility and productivity in this report. In Appendix F a more extensive description of the KPI's can be found.

Table 3-1 - Overview of defined KPI's for the catering distribution network

Category		KPI	Unit
Reliability of inventories	1a	Correctness deliveries suppliers (quantity of products)	%
	1b	On time delivery rate suppliers	%
	1c	Discrepancy between actual stock levels and SAP values KCS Warehouse	%
	1d	Correctness deliveries shipments to OS (quantity of products)	%
	1e	On time delivery rate LSP	%
	1f	Discrepancy between actual stock levels and SAP values OS	
	1g	Correctness deliveries to KCS Centrum (quantity of products)	%
	1h	On time delivery rate to KCS Centrum	%
	1i	Discrepancy between actual stock levels and SAP values KCS Centrum	%
Costs	2a	Non-performance costs – Repair transportation costs area[12]	# and €
	2b	Non-performance costs – Repair transportation costs central[13]	# and €
	2c	Non-performance costs – Obsolete products	% and €
	2d	Non-performance costs – Deteriorated products	% and €
	2e	Non-performance costs – Custom fines	€
	2f	Value of inventory – Central warehouse	€
	2g	Value of inventory – Warehouses outstations	€
	2h	Value of inventory – In pipeline	€
	2i	Extra warehousing	Hours
	2j	Normal transportation costs	€
Quality	3a	Accuracy PAX forecast	%
	3b	Accuracy forecast consumption	%
	3c	Accuracy lead time LSP	%
	3d	Quality of supplier delivered products conform spec	%
	3e	Damaged goods due to transportation to OS	%
	3f	Corporate Social Responsibility (CSR) factors	Misc.

[12] *RTC area*: the combined costs spent to repair irregularities in area inventory management.

[13] *RTC central*: the combined costs spent to repair irregularities in central inventory management.

3.3.3 *Problem emerging at stratum 3*

At this stratum one major setback can be spotted. This concerns the lack of a control loop in order to gain knowledge about the on board consumption of catering articles. In order to become the best service oriented airline in the world, KLM must be able to offer passengers on different flights different sorts of services depending on destination, type of passengers, time of day and flight length. For this goal to be achieved, extensive knowledge about consumption patterns of passengers must be known.

However, there is no structural information about the on board consumption. The consequences of this lack of information are large:

- It is not possible to offer flight-dedicated services[14]. This means that KLM cannot fulfill the needs of different sorts of passengers on different sorts of flights.
- The area planning department lacks valuable knowledge in order to optimize their inventory management of outstations. When the consumption pattern on a specific flight is known, this forms a basis for which products to send in which amounts to the outstation (more efficient inventory management).
- There is no knowledge about the performance of a catering load on a flight. The measured consumption on EUR-flights shows that on a lot of flights there is a structural overload of articles, resulting in structural higher operating expenses for the company.
- Because of structural overloading, the total inventory level in the distribution network is higher than necessary. This also adds to the operational costs, resulting in declining yields.

3.3.4 *Conclusions stratum 3*

Stratum 3 gives a good overview of the different functions that are involved in the distribution of catering articles of KLM. The functions are explained briefly and the important process criteria have been described. The problem about lacking knowledge about on board consumption has been identified. In order to identify the other problems that KLM faces it is necessary to zoom in one more time. Therefore, in the next sections specific functions of stratum 3 are being explained in more detail. Also a description of the development of the product portfolio is given, because of the large influence this process has with respect to the distribution of catering articles.

[14] There are a few route-dedicated products (Fernandes on flights to Surinam, Sake on flight to Japan, Ginger ale on flights to Canada), but this concerns a single product per flight.

3.4 Stratum 4a – Manage central inventory

Because the important performance indicators for the distribution network are the reliability of inventories, quality and costs, the places where all these parameters come together are interesting to investigate. For the central warehouse, the mix of parameters is obvious. Therefore, the performance of the central inventory management is being explained in this section.

The challenge is to find the right balance between assuring a satisfactory reliability of the inventory levels, while maintaining the costs at the lowest level possible. The process as it is organized in the current situation is depicted in Figure 3-4.

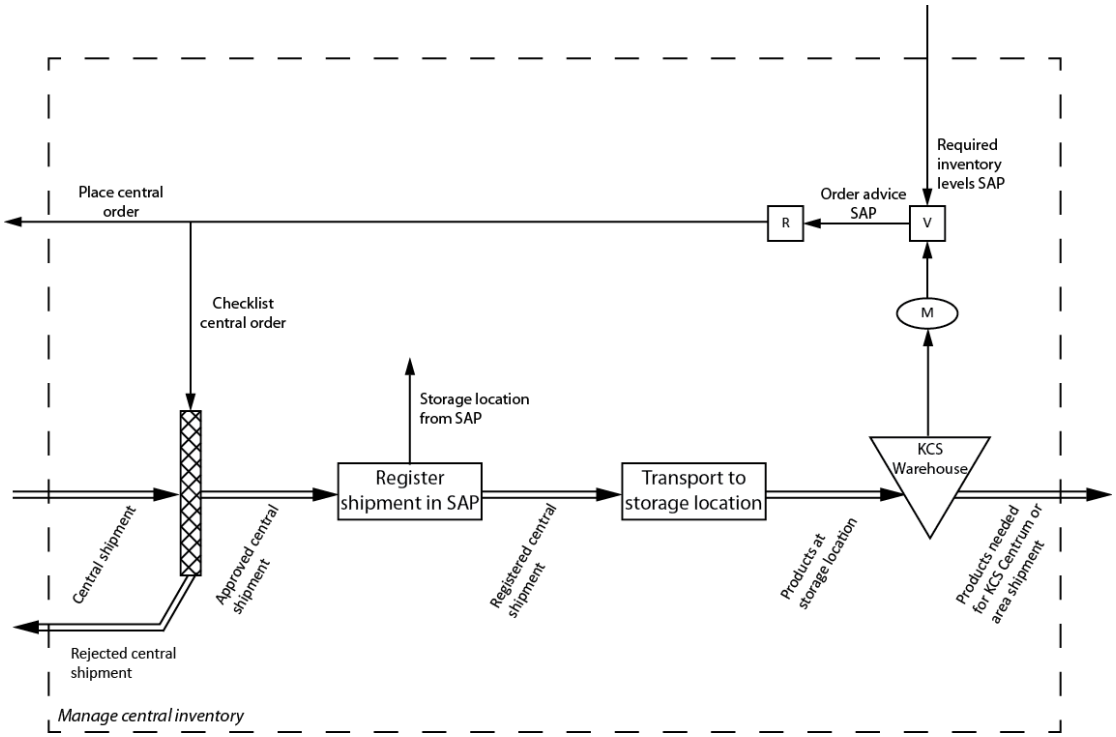

Figure 3-4 - Stratum 4a Manage central inventory

3.4.1 Observations around central inventory management

Based on the figure above, some observations are made with respect to dissatisfactory performance of the inventory management of the central warehouse at Schiphol Noord. These observations are being explained and related to important process parameters, as defined in the previous paragraph.

3.4.1.1 Shortage of theoretical knowledge about inventory management

The planners work with SAP, a well-known inventory management IT-system. The system is based on theoretical frameworks of inventory management. In order to understand the system and for instance the order advices it produces, it is important to have a clear

understanding of the theory of inventory management. Unfortunately, the planners do not have extensive knowledge on this subject. The consequences of this lack of knowledge are that the effectivity and productivity of the planners are not as good as they could be.

3.4.1.2 *No standardized information sharing with suppliers*

There are no strict guidelines concerning the way of communicating with suppliers. This causes problems in a two possible ways:

- Suppliers are not required to send an order confirmation; therefore there is no definitive knowledge about the order being accepted or not.
- Order information is mainly exchanged by e-mail to specific persons. When this person is not in the office for a longer period of time, the supplier might not process the order while KLM is not aware of this fact.

The consequences of these observations are that knowledge about non-accepted or non-processed orders always pops up when it is (almost) too late. This results in a lot of repair-work being done, which is very time-consuming and therefore costly.

3.4.1.3 *Differences between registrations in SAP and actual inventories*

When the operators at KCS Warehouse register a delivered shipment in SAP, the system automatically assigns optimal storage locations to the different products. It is then the responsibility of the operators to place the products at their assigned storage location. This does not always happen, but there is no feedback mechanism to check it. This means that discrepancies between the digital information and the actual location of inventories arise. Ultimately, this leads to products being lost and unreliable information in SAP.

3.4.1.4 *Lack of standardized process control*

There are no standardized process control loops defined. This means that structural evaluation and regulation of important process parameters is not executed. This means that valuable information is not extracted from the process.

For instance, there is no control loop built in for vendor rating. When executed, vendor rating could lead to improvements in effectivity. There also is no evaluation of the inventory articles in order to differentiate different groups of products (fast movers vs. slow movers for example). When differentiated product groups are defined, the management of different articles will become more clear and can be fine-tuned. Fast moving articles require a different approach than slow moving articles.

3.5 Stratum 4b – Manage area inventories

The central inventory is used for sending area shipments to the outstations and to supply the working stock for KCS Centrum. Especially the distributing of area shipments is interesting with respect to the important process parameters, because of the small margin for errors due to long lead times and difficulties in process control. The distribution of area shipments to outstations is depicted in Figure 3-5.

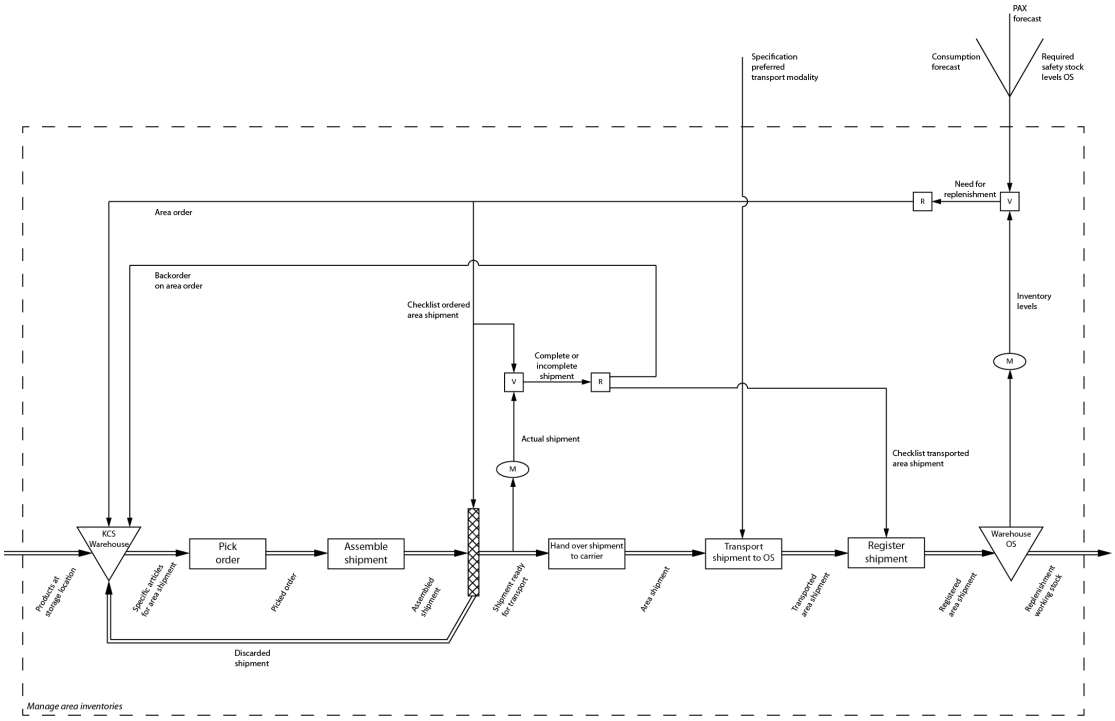

Figure 3-5 - Stratum 4b Manage area inventories

3.5.1 Observations around management of area inventories

Based on the figure above, some observations are made with respect to dissatisfactory performance of distribution of area shipments to outstations. These observations are explained and related to important process parameters, as defined in the paragraph about stratum 3.

3.5.1.1 Incorrect standards for inventory management

Inaccurate information from PAX-forecast. This results in the fact that currently the replenishment is done assuming 100% PAX-density on the flights.
Also, there is no accurate knowledge the consumption per PAX. Therefore, efficient replenishments based on actual needs are not possible.
Because of the lack of accurate information about PAX-forecasts and the consumption per PAX, it is not possible to generate custom-made replenishments for outstations. Therefore, substantial safety stocks have been installed (3 full weeks) that result in high costs. Because of the lack of knowledge about consumption, no effective inventory management can be

done. No logic decisions can be made about the types and amounts of products to be held in stock at outstations.

3.5.1.2 No exact information about local inventory levels

Because KLM specifies that caterers only need to provide information about the inventory levels in their warehouse (and not also about the working stock), the exact inventory levels are not known. This means that when just before the scheduled count of inventory levels a pallet with Coca Cola has been transported to the working stock, it seems that this entire pallet has been consumed in that period of time. This results in sending a new pallet, while actually the pallet is only just transported to the work floor. Without exact knowledge about inventory levels it is much harder to efficiently replenish the inventory at an outstation.

3.5.1.3 Incorrect standards for decision of transport modality

In order to minimize the costs, the preferred transport modality for a shipment is examined. Usually, sending shipments trough sea freight is the cheapest option. However, the decision between using sea- or airfreight is not made with complete information. There are a lot of factors that are left out of the equation, meaning that the decision is currently based on cost price only (of course the check whether sea freight is possible is done), but no cost factors concerning possible risks with local customs, unstable lead-times, etc. are taken into account. The result is that it is not always clear whether choosing a transport modality is leading to a minimization of costs.

3.5.1.4 Incomplete control loop sending area shipments at KCS Warehouse

The area shipments are prepared at KCS Warehouse. A single operator is dedicated to assemble a shipment. However, two problems came up with respect to preparing shipments.

The first problem is that operators do not always register the products they take out of inventory. This leads to discrepancies between SAP and the actual inventory. This forms a problem for the central planning department and could result in not having enough products for another shipment or order from KCS Centrum.

The second problem is that there is not a complete feedback loop when the shipment is checked before it is handed over to the logistic service provider. For example, a certain product that is needed in the shipment is not present in the warehouse when the operator is picking the order. But it is possible that this product is delivered somewhat later that day. The logical thing to do is to check whether products that were not present at the beginning of the day, have been delivered later on so that the shipment can be completed after all. This

would prevent sending a very expensive backorder or not having the product in stock at the outstation for a certain period of time. This simple feedback loop is not present in the current situation.

3.5.1.5 Lack of standards on desired service levels

The operational planning department needs well-specified standards for them to be able to work according to specifications. These standards include agreements on desired service levels of the inventory at the outstations, on service levels with the logistical service providers and, maybe the most important of them all, clear agreements on the desired service levels on the service that Product Management wishes to serve the passengers. These standards are not defined, or very poorly and in an unclear way. This has negative influence on the effectivity of the supply chain, it also often results in a lot of extra work for the planners which has a negative consequence on their productivity.

3.5.1.6 Unclear lead-times of all steps in the distribution network

There is no clear definition of the lead-time of the different process steps needed in the distribution network. This makes the planning of shipments complex, because there is an uncertainty in the required amount of time it takes to have replenishments at the desired locations. This effect is increased by the fact that there exist differences between the lead-times that SAP uses and the actual lead-times (for instance, SAP uses a lead-time of 52 days for the outstation Xiamen in China, while the actual lead-time of Kuehne Nagel is 71 days). This means that the reliability of the inventory at KCS Warehouse is compromised.

3.5.1.7 Shortage of theoretical knowledge about inventory management

The planners work with SAP, a renowned inventory management IT-system. The system is based on theoretical frameworks of inventory management. In order to understand the system and for instance the order advices it produces, it is important to have a clear understanding of the theory of inventory management. Unfortunately, the planners do not have extensive knowledge on this subject. The consequences of this lack of knowledge are that the effectivity and productivity of the planners are not as good as they could be.

3.6 Develop & maintain product portfolio KLM Catering

This section covers the development of the product portfolio of catering articles, as well as maintaining the portfolio. Although this system is not directly involved in the worldwide distribution of catering articles, certain outputs of it do have a large influence on the operational management of the product portfolio. In order to make this clear, this section is added to the analysis. The general form of the development of the product portfolio can be modeled as an *innovation model* as defined by Veeke, Ottjes and Lodewijks[15] and is depicted in Figure 3-6.

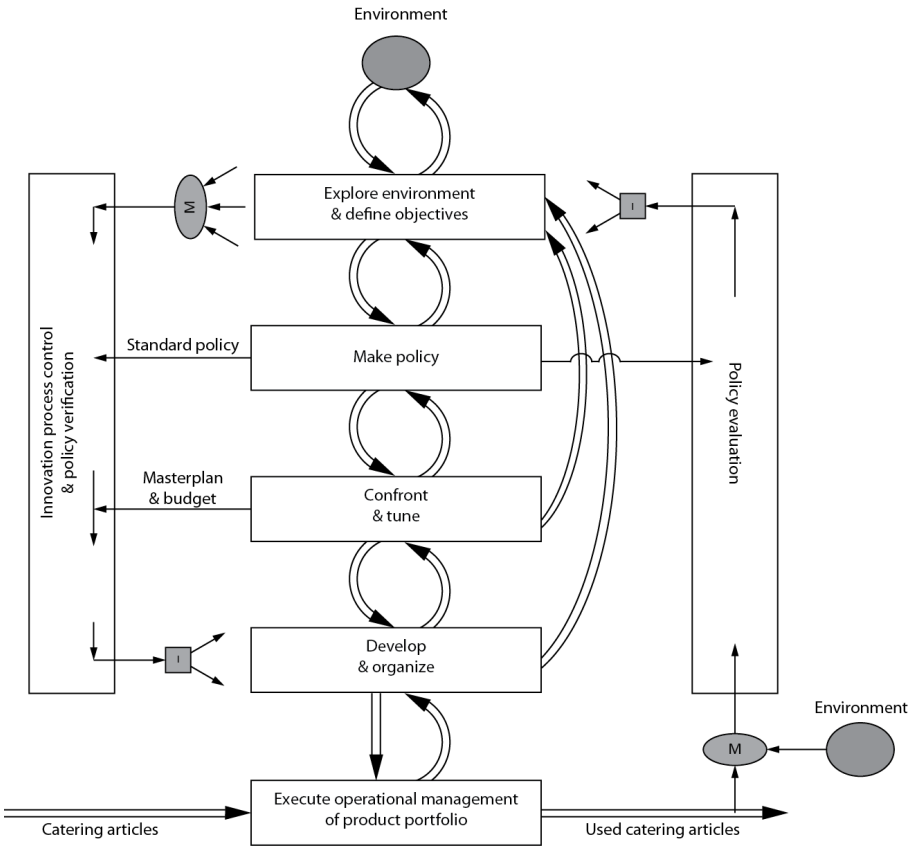

Figure 3-6 - Develop and maintain product portfolio KLM Catering

3.6.1 Explanation of functions

3.6.1.1 Explore environment & define objectives

The development of the product portfolio is the responsibility of the CIM-department Product Management, as explained in the previous chapter. The portfolio is bound to general requirements imposed by the corporate Marketing department. Product Management has identified three different product categories, aimed to satisfy three different sorts of passengers: (1) World Business Class, (2) ICA-M and (3) EUR. Within EUR there is a difference between the European Business Class and the European Economy Class. For these

[15] H.P.M. Veeke, J.A. Ottjes, G. Lodewijks, *The Delft Systems Approach*, pp. 170.

product categories, PM is constantly busy to investigate the needs and wishes that emerge in the market and formulates their strategic goals based on market demands. All the work eventually leads towards the corporate goal to become the best service oriented airline in the world. Additional goals are to show important brand pillars *International Dutch, Energy* and *Story Telling*[16].

3.6.1.2 Make policy

The three different product categories have a unique way of approaching the passenger's need. Logically, the expectations of a passenger flying World Business Class are higher than those of passengers flying economy class on short EUR-flights. In this step the policy for the different product categories is formed. The policy concerns specifying which service levels, how many and which sort of services are attributed to the product categories, etc. It also encompasses the planning for when changes or new concepts must be fully operational. Up to this level, the work is entirely done by Product Management.

3.6.1.3 Confront & tune

In this step, the actual products are assigned to a specific product category. This involves the development of new products, the modifying of existing products and the replacement of existing products. Here there is a need for collaboration with other stakeholders, both internal (NSM, KCS) as well as external (potential suppliers, designers). Prototypes are developed, samples are sent for evaluation and product specifications are regularly subject to change. The final product must have been approved by three departments: (1) Product Management for the definitive prototype and technical specifications, (2) Loading & Ordering for the placement of the product in loading equipment and (3) Supply Chain Specialist for logistical specification. The result is an approved final product and a master planning specifying the important milestones and timing for introduction[17]. The supplier is selected by Procurement.

[16] These are the three pillars around which the product portfolio is developed. Source: W. Spelt (Director Product Management).

[17] The introduction can be a 'hard' transition (a product is introduced on a fixed date) or a 'soft' transition (the old product is used until the stock is depleted, after that the new product will be used).

3.6.1.4 *Develop and organize*

This last step mainly concerns how to translate the new ideas into practice. In order to have a successful implementation, it is necessary to have the products available at the right moment in the right amounts at the right locations. Therefore, the planning department and the supply chain specialists determine at which outstations the products must be held in stock, the forecasts for usage, the safety stocks that must be installed, preferred mode of transport and the lead-times attributed to this, the contact with the logistical service providers and they make sure to keep track of the timing attached to the introduction.

3.6.1.5 *Policy evaluation*

It is important to measure whether the introduction of a product is a success. The passenger satisfaction is the most important factor for success. This factor must therefore be measured and it must be evaluated whether the results are satisfactory with respect to the goals and policy that was defined in an earlier stage. This is the responsibility of Product Management and it is carried out using specific questionnaires or standard passenger satisfaction forms.

3.6.2 ***Observations around development of product portfolio***

Based on the figure above, some observations are made with respect to factors that have a negative influence on the operational management of the product portfolio (the distribution network).

3.6.2.1 *Absence of clear normative outcomes for the operational management of the product portfolio*

Product Management carefully executes the development of the product portfolio. However, hereby the focus lies on the determination of which product to incorporate, which design is best suitable for KLM etc. Generally speaking, the overall attention lies with the 'soft' side of developing a portfolio. The 'hard' side, including important normative outcomes that are necessary for successful and objective operational portfolio management is largely neglected. The result is that it is not possible for NSM to evaluate the performance of the distribution network with respect to performance standards, leading to performance assessment between Product Management and NSM based on 'gut feeling'. The absence of standards makes it also impossible to accurately determine economic inventory levels at both the outstations as well as the central warehouse.

3.6.2.2 Conflicting interests between NSM and Procurement

Because of the organizational structure, conflicts of interests arise between NSM and Procurement. The employees of procurement are mainly evaluated based on the results they get on cost price of products. Obviously, purchasing large quantities at once leads to lower cost prices. However, having suppliers deliver in larger quantities can have negative effects from a logistical point of view. It leads to higher storage costs and higher risks.

3.6.2.3 Undefined standards concerning lead-times of different steps

Lead-times of the different steps in the innovation products can usually not be specified, because of the looping character of different steps. However, with respect to the development of the product portfolio, there is an unnatural imbalance between the time the conceptual phase takes (this phase includes the exploration of the environment, goal definition, policy making and confrontation and tuning) and the practical phase (developing and organizing). This means that when the conceptual phase is finished, the demands with respect to available time towards the practical phase are unrealistic.

3.6.2.4 Two-way stream? Not really …

In addition to the previous observation, the looping character of the innovation process is not really executed between the conceptual- and practical phase. This means that when notifications about possible logistical problems come up, there is not much room to go back towards previous steps in order to come up with a better overall solution.

3.7 Problem statement after analysis

This chapter is dedicated to the identification of problems in KLM's worldwide catering distribution network. Problems with respect to the performance on certain, by KLM defined, important indicators. These *key performance categories* were: (1) reliability of inventories, (2) quality and (3) costs. The performance category *quality* is not defined in detail; it encompasses all aspects that have something to do with quality (quality of shipments, quality of products, quality of service etc.).

These KPI's were compared with the important process criteria as defined by Bikker and In 't Veld. It can be concluded that with respect to the defined KPI's of KLM, the process criteria effectivity, flexibility and productivity are the most important ones. These factors are translated into measurable performance indicators, specified for this situation.

While zooming in on the catering distribution network, it became clear that three different sort of problems can be identified with respect to the performance of the system:

1. Important process control loops are not well executed or are non-existent,
2. The employees involved in the operational inventory management lack basic knowledge about the theory behind inventory management,
3. A lack of very substantial knowledge about the on board consumption of passengers.

The consequence of these problems is that in the current situation efficient replenishments for outstations based on actual needs are not possible, leading to non-optimal inventory management throughout the distribution network.

The analysis confirms the need for the development of structural process- and function control. The planning & control model that KLM would like to have will be the aim of the remaining chapters of this thesis. This model mainly focuses on the first problem, but the second and third problem will be addressed as well.

The important research questions that need to be answered are:

- How can the reliability of the inventory levels at KCS Warehouse be increased?
- How can the reliability of the inventory levels at outstations be increased?
- Which standards must be developed and/or specified in detail to be able to improve the performance on reliability of inventories and costs in a structural way?

Answering these questions will result in insight in the important parameters to get an objective view on the performance of the distribution network. When this objective view is developed, it is possible to define clear goals and implementation plans to increase the performance towards acceptable and desirable levels.

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4 Solutions to identified problems

4.1 Necessary boundary conditions for distributing catering articles

As stated in the previous chapter, there are no clear normative outcomes from the developing and maintaining phase concerning the product portfolio. However, there are a number of boundary conditions that need to be unambiguously defined in order to be able to assess the performance of the distribution network in an objective manner.

4.1.1 Clear normative outcomes of portfolio development

The product groups include a wide variety of products, ranging from specific chinaware developed by the Dutch designer Marcel Wanders to plain and simple toilet paper. Both are important products, but their importance originates from a very different angle. The Marcel Wanders (MW) chinaware is a strategic product for KLM, exhaling luxury and Dutch character for the business class passenger. The MW-products are uniquely designed for KLM and are produced by a specific supplier. Toilet paper is not a strategic product at all, but still it must be present in abundance during a flight at all times. It can also be acquired through a lot of different suppliers.

Dealing with varying types of products in a successful manner requires a clear classification of products within the product groups, assigning class specific attributes like for instance strategic importance, safety importance and customer appreciation to them. The result of such a classification is that a service level is assigned to each product (or group of products). In this case the service level is defined per flight, meaning that for a can of soda with a service level of 90% that nine out of ten passengers that request this specific soda will have to be satisfied and that a 'stock-out' may occur in 10% of the cases. One can imagine that the required service level of the MW chinaware should logically be higher than the required service level of a toothpick.

Another consequence of the classification of the products in the portfolio is that the different categories of products can be treated differently with respect to purchasing and inventory management. Kraljic[18] identifies four different product categories with corresponding purchasing strategies, which also have consequences with respect to logistical aspects. These product categories are assessed on the influence they have on the financial result and the risk of supply they impose. The categories are:

[18] P. Kraljic, *Purchasing must become supply management*, pp. 109 – 117.

1. *Strategic products;* These products are obtained from a single supplier or products of which the supply on short and long term cannot be guaranteed and which also represent an important value of the end product. The advised purchasing strategy is a strategic partnership with the supplier.
2. *Bottleneck products;* These products represent a relative low monetary value, but they are vulnerable with respect to their supply. The advised purchasing strategy is to secure continuity of supply.
3. *Leverage products;* These are products that can be obtained from different suppliers and which represent a relatively high important value of the end product. The advised purchasing strategy is competitive bidding.
4. *Routine products;* These are products that do not impose problems with respect to purchasing. They represent a low value and have a lot of alternatives for suppliers. The advised purchasing strategy is systems contracting.

The categories described above are depicted in a schematic overview in Figure 4-1.

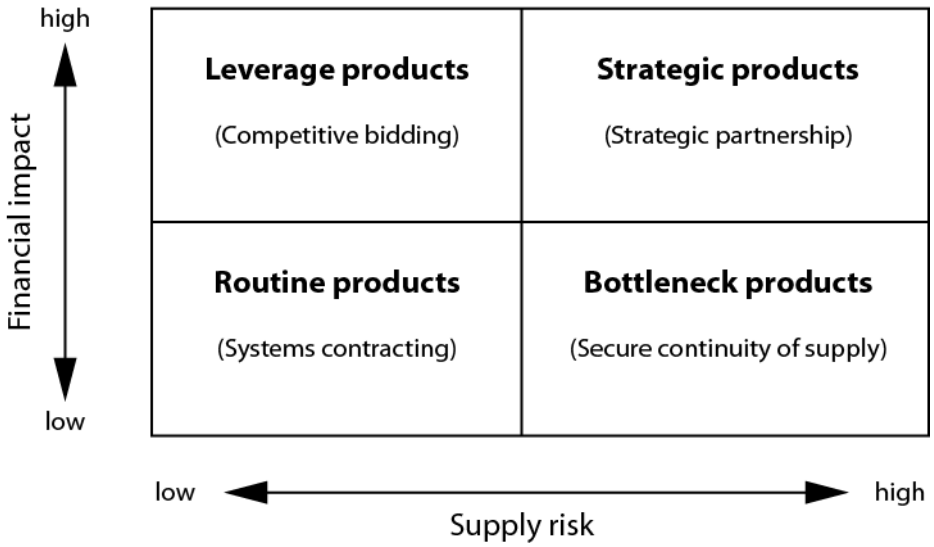

Figure 4-1 - Kraljic matrix for purchasing strategies

4.1.2 Knowledge about on board consumption

Besides the need for clearly defined standards coming from the higher echelon (product portfolio development), there is another boundary condition that is essential in order to be able to improve the performance of the distribution network with respect to the important process parameters effectivity, productivity and efficiency. It concerns the need for knowledge about the on board consumption of catering articles by passengers.

There are three reasons why it is important to be able to accurately forecast the on board consumption: (1) it enables KLM to identify destination-specific demands of passengers, (2) it enables KLM to reduce the on board oversupply of catering articles and (3) it enables KLM to improve the effectivity and efficiency of providing the passengers their catering service (i.e. improve the inventory management and corresponding supply chain). These reasons will be explained in more detail.

4.1.2.1 *Identify destination-specific demands of passengers*

This advantage that follows of knowledge of on board consumption is important with respect to the ambition of KLM to become the best service oriented airline. A part of this vision is to be able to offer destination-specific catering services to the passengers. The first steps towards this direction are already taking place, for instance on the flights to Surinam a specific type of soda, called Fernandes, is served. Another example is the serving of sake (alcoholic beverage originating from Japan) on flights to Japan. However, these *route dedicated products* are still very small in numbers.

When a way of collecting knowledge about trends in demands of passengers on flights is found, real destination-specific catering services can be developed. However, an important remark is that knowledge about these trends is important, but the organization is not operationally ready for taking these steps already. A lot of alterations in IT and operations are needed in order to start with destination-specific catering loads, both at KLM Inflight Services as well as at KCS.

4.1.2.2 *Reduce the on board oversupply of catering articles*

Although it is important to maximize the service to the passenger and therefore to make sure that there are enough catering products on board, a structural oversupply on board is not desirable. Based on field experience, it was assumed that such an oversupply would be present on a lot of flights. One of the requests for this graduation project was to explore this and provide more insight in the on board consumption and corresponding possible oversupply.

To this end, in March and April of 2012 a total of 215 flights have been examined by counting all the products that returned unused. For this inquiry only EUR-flights were used, because these flights are loaded for both the out- as well as the homebound flight at KCS Centrum and therefore making it easy to close the loop and acquire accurate data. The assumptions about possible oversupply on board were confirmed by these measurements. Covering the entire spectrum, for almost every product there was some sort of oversupply.

The result of this is that the DOW[19] of an aircraft is higher, leading to higher operational costs and (for ICA-flights only) leading towards loss of potential cargo sales.

This shows that eliminating oversupply results in substantial cost savings. After thorough analysis, the first adaptations of the catering load on EUR-flights resulted in a saving of € 50,000 on operational costs, with the assignment to further optimize the load in the rest of 2012 and 2013 with the goal of saving over € 500,000 in total for EUR-flights. Realizing the potential savings for ICA-flights, where the catering load is on average 5 times larger and heavier than on EUR-flights, the estimated savings for ICA run up to a few million euros. Although at first it was intended that I would also cover the ICA-measurements and analysis, during the analysis of the EUR-flights it became clear that this would not be a feasible goal. Therefore, in the midst of August 2012, Mr. W. Kooistra was hired to set up and execute a research plan to investigate the on board consumption on ICA-flights, as well as to develop a forecast model for the on board consumption.

4.1.2.3 Improve the effectivity and efficiency of providing the catering service

The third and last advantage of accurate knowledge about consumption is concerned with the distribution of catering articles to the outstations. When the consumption pattern of passengers on a homebound flight to Amsterdam from an outstation can be accurately forecasted, it is also possible to make the inventory management and corresponding distribution network more efficient. The determination of stock levels at the outstations can be customized to a specific outstation, as well as the safety stock levels. Also, an objective evaluation of which products to have in stock at the outstation can be made.

4.1.3 Conclusions on necessary boundary conditions

The paragraphs above illustrate the importance of a clear definition of standards for the operational management of the product portfolio as well as the importance of accurate knowledge of on board consumption by passengers. Especially the second boundary condition is of vital importance for the success of the new control model. When knowledge is developed, the standards (f.i. service levels) from the higher echelon can be defined which are used as leading process norms for the new control model. Extensive effort has been put into gaining knowledge about the consumption on EUR-flights. These results lead to the assumption that for the design of the new control model, the consumption of passengers is known to KLM and it can be used to determine the distribution of catering articles to outstations.

[19] DOW stands for Dry Operating Weight and is used for calculating the necessary amount of fuel for a flight.

4.2 Definite formulation of performance indicators

Before the development of a new control model for the distribution network of NSM can take place, it is important to determine which performance indicators are of critical importance. Also, the desired performance levels must be determined. The defined KPI's determine for a large part the design of the control model, since the goal of a control model is to gain insight in and, when necessary, influence process parameters in order to achieve pre-determined system goals. The KPI's defined in section 3.3.2.7 are used as the important performance indicators for the new control model.

4.3 Design of control model for the distribution network

Veeke, Ottjes and Lodewijks[20] distinguish four essential aspects that enable a process in a system to be controlled properly:

- There must be an objective; defining which output or which state the system should achieve
- The system must be capable of realizing this objective
- It must be possible to influence the system's behavior in one way or another
- The relationship between the interference and the resulting behavior must be known.

The term control is discerned into two different sorts of control: (1) function control and (2) process control. Function control concerns the combination of the translation of requirements into measurable standards (*initiate*) and the evaluation of results expressed in terms of the original requirements (evaluate). Function control does not react to disturbances, while it assumes an ideal situation. However, the ideal situation will generally not occur, therefore in order to deal with disturbances, process control is introduced. It consists of two forms of control: (1) feed forward and (2) feedback. Feed forward control is best described as *cause determines intervention*, meaning that the disturbance is determined in the input or throughput, after which the influence is compensated for. Feedback, however, is *result determines intervention*. Here the consequence of a disturbance is measured and acted upon.

The start of developing the new control model is to clearly formulate the system's goal. As stated in the previous chapter, the goal of NSM is *to ensure the availability of needed catering articles at all locations while minimizing the total cost*. The strategic choice of having a centralized warehouse and decentralized distribution to the outstations is considered a boundary condition and seems the preferable option given the demands of KLM towards the product portfolio.

[20] H.P.M. Veeke, J.A. Ottjes, G. Lodewijks, *The Delft Systems Approach*, pp. 62.

The redesigned control model consists of the same three stages as strata 3, 4a and 4b in the previous chapter. This way, the important control loops can be more clearly explained. Figure 4-2 on the next page shows the redesigned control model for stratum 3. With this new control model, the focus for distributing catering articles lays on making decisions based on customer behavior. This means a shift from an entirely PUSH-oriented distribution network towards a demand-controlled PUSH distribution network (it is not going to be a complete PULL model, as the caterer will not be made responsible for the overall inventory management at the outstation, this will remain the responsibility of NSM).

4.3.1 Customer behavior triggers distribution of articles towards outstations

The entire supply chain is developed in order to satisfy passengers. Therefore, the decisions are made from 'right to left', meaning that the important decisions around the distribution are based on passenger demand. Obviously, it is not possible to react to realtime demand, because the articles are stored at the warehouse at Schiphol Noord and the passengers are on flights all over the world. Therefore it is important to create a model that is able to accurately forecast the consumption of a passenger on a specific flight by measuring the on board consumption.

Another important factor that is needed in order to be able to make the right decisions around inventory management is the predicted number of passengers on a flight. Obviously, when a flight has a structural passenger rate of around 50%, it would make no sense to control the inventories based on a passenger rate of 100% because of higher costs involved. To this end, a new tool called PTRA is being developed, ultimately enabling KLM to accurately predict the number of passengers on a specific flight.

These two factors combined, namely knowledge about the average consumption per passenger on a flight and accurately predicted PAX-numbers, can be used to make the following distributing decisions:

- Which part of the product portfolio should be held in stock at the OS?
- Which transport modality is best suited for replenishing this OS?
- Which frequency of replenishing will be used?
- Which inventory levels (including safety stock) should be installed?

These decisions can be made for all the outstations. This ultimately leads towards knowledge about the forecasted total usage of articles and the distribution of needed replenishment shipments throughout time. Based on these data, the important decisions around the central inventory levels (including safety stocks) at KCS Warehouse can be made.

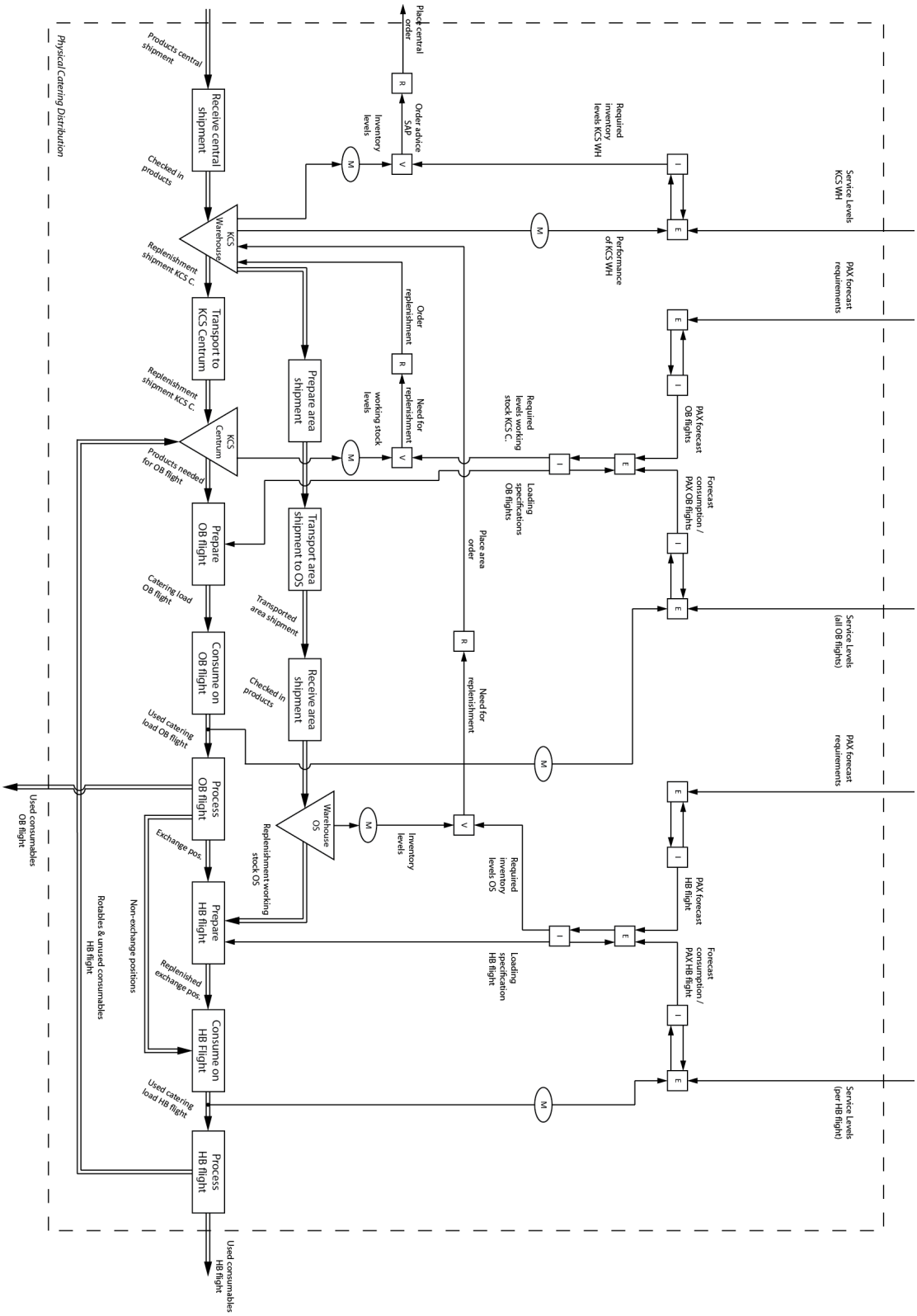

Figure 4-2 - Redesigned stratum 3 control model for the catering distribution network

4.3.2 Design of control model for central inventory management and the corresponding supply chain

By zooming in on the specific functions of stratum 3 that are concerned with the central inventory management, some more specific control loops can be assigned in order to enable KLM to objectively asses and influence the performance of the central inventory supply chain. The redesigned control model is depicted in Figure 4-3 on the next page. The important changes with respect to the as-is situation will be explained in the following paragraphs.

4.3.2.1 *Exchange of order information*

In order to create clarity around orders placed at suppliers, it is recommended to install a closed control loop concerning the processing of orders. By doing this, the reliability of the inventory is increased, because the planning department knows at all time whether orders are accepted, changed or possibly rejected by suppliers. It also diminishes the possibility of orders that are not processed at suppliers because the involved employee(s) of the supplier do not receive or read their order books (for instance because of holidays).
There are possibilities to automate this communication between buying and supplying parties, most commonly known under the general term *electronic data interchange* (EDI). EDI is the interorganizational exchange of business documents in structured, machine-readable form, typically between independent application systems[21]. Implementing EDI has, next to the advantage of a higher level of certainty about orders and deliveries, numerous other advantages, including reduction of paper work, reduced inventory levels and reduced error rates.

4.3.2.2 *Check on correctness of located products*

Another way of improving the reliability of the inventory from an operational point of view is to build in a closed loop concerning the placement of received central shipments. By requiring the confirmation that a registered unit of measure is placed at the location that SAP has indicated, no more products will be lost. This also decreases the non-performance costs as defined in Table 3-1.

[21] Electronic Data Interchange, Encyclopedia of Information Systems pp. 47.

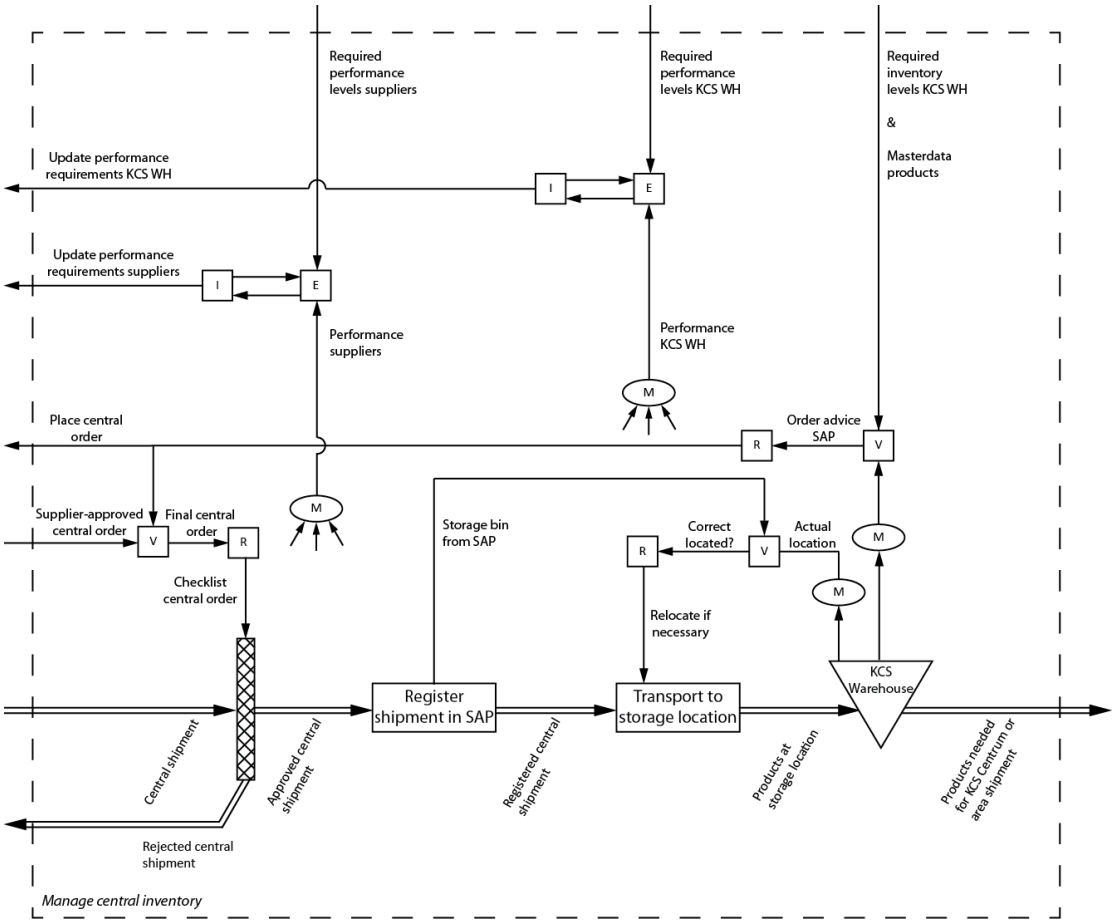

Figure 4-3 - Redesigned stratum 4a control model for central inventory supply chain

4.3.2.3 Vendor management

An absolute necessity for improving the control over the central inventory management is to incorporate structural vendor management. By assessing and evaluating the performance of suppliers it is possible to present them an objective overview of their performance which can be compared with the contractual agreements that have been reached between the supplier and KLM.

The supplier's performance should be evaluated on a number of parameters:

- Correctness of quantities of deliveries
- Correctness of quality of deliveries
- On-time delivery rate

By measuring these parameters, an objective overview can be presented to the suppliers every month whether the agreed service levels are being met. When immediate actions are required because of poor performance, these can be carried out. To evaluate the performance in a structural way as well as to improve the collaboration between KLM and its

suppliers, it is recommended to have a quarterly meeting with the supplier to evaluate this period's performance and discuss possibilities to improve the performance in a structural manner when necessary.

4.3.2.4 Warehouse performance management

Because KCS B.V. is a 100% subsidiary of the KLM Group, it is officially a third party to which the warehousing is outsourced. This also imposes the need for a structural performance evaluation of the warehousing activities, just like the need for vendor management. Important parameters concerning performance evaluation of the warehousing are:

- Discrepancies between actual stock levels and SAP values
- Non-performance costs concerning deteriorated and/or obsolete products[22]
- Handling costs
- Theft / loss of products

Here also a structure of monthly performance updates and quarterly evaluation and possible updating standards is recommended. These measures also improve the reliability of the inventory and lower the costs.

4.3.2.5 Improving quality of masterdata

Masterdata is reference data about certain important properties of a product, which will be shared in the diverse applications that are being used to process the products within the organization. Examples of masterdata regarding inventory management are sizes, weight, preferred packaging unit, price etc. In the current situation the responsibility for maintaining masterdata is very shattered throughout the organization, resulting in incomplete and non-accurate values. Supply Chain Specialist P. van Dijk has started a project to address these issues and improve the quality of masterdata. This will ultimately result in an increase of the reliability of the inventory, as well as the quality.

Anno 2012, a lot of standardized information can be digitally assigned to a product by its manufacturer. By implementing for instance a system developed by GS1[23], the acquisition of masterdata can be automated, leading to higher quality of masterdata.

[22] This is partially the responsibility of KCS Warehouse, but also partially the responsibility of the planning department of NSM. When non-optimal replenishment strategies are used, the risk of obsolete products becomes higher.

[23] See http://www.gs1.org for more information about the information management system developed by this company.

4.3.2.6 Combined effort towards optimization in the central supply chain

By focusing on possibilities to improve KLM's own performance substantial promising improvements emerge. But by extending the focus to KLM and its direct suppliers possibilities for mutual benefits emerge as well. For the central supply chain, the most obvious field to promote combined efforts toward improvements is the inventory management of the central warehouse, because by sharing responsibility for correct inventory management mutual benefits can be achieved resulting in improved reliability of the inventory and lower costs for KLM.

An appealing option to this end is implementing *Vendor Managed Inventories* (VMI) in combination with EDI (as described in paragraph 4.3.2.1). VMI is a supply chain system whereby a supplier assumes responsibility for maintaining inventory levels and determining order quantities for its customers[24]. It requires the implementation of an information sharing process across the supply chain using a communication technology, such as electronic data interchange (EDI)[25]. Multiple advantages of VMI adoption have been reported in literature, among which are reduction in inventories, reduction in lead times, shorter order intervals and more frequent deliveries, increase in customer service, increase in inventory turns and cost reductions[26].

In this case, the cost reductions for KLM do not end with the reduction of non-performance costs and extra work. The most cost reductions originate from the fact that when VMI is implemented with a certain supplier, the total value of the inventory of this supplier will no longer appear on KLM's balance, but on the supplier's. With a total financial value of the central inventory of around 5,8 million euros; the potential cost savings are substantial. Further investigation into the possibilities and risks of implementing a collaborative system to manage the central inventory is needed.

[24] Y. Dong et al, *Environmental determinants of VMI adoption: An exploratory analysis,* pp. 1.

[25] S. Rouibi, P. Burlat, *The Impact of the Vendor Managed Inventory on Supply Chain Performance*, pp 2

[26] Multiple sources, see literature list.

4.3.3 Design of control model for area inventory management and the corresponding supply chain

By zooming in on the specific functions of stratum 3 that are concerned with the area inventory management, some more specific control loops can be assigned in order to enable KLM to objectively asses and influence the performance of the area inventory supply chain. The redesigned control model is depicted in Figure 20 on the next page. The important changes with respect to the as-is situation will be explained in the following paragraphs.

4.3.3.1 *Add-the-missing at final check of area shipments*

In order to avoid the dispatch of unnecessary incomplete area shipments, the implementation of add-the-missing during the final check after the assembly of an area shipment is recommended. It is possible that at the moment of picking the order for the area shipment a certain product is out of stock. When this product is delivered after the picking moment but before the final dispatch of the area shipment, it is not necessary to create a backorder for this specific product. However, in the current situation the add-the-missing is not carried out, leading to an increase in costs because of the possible sending of a BBO and the extra work that is needed for a backorder. By implementing the add-the-missing, the reliability of the inventory can be increased and unnecessary failure costs regarding this topic can be avoided.

4.3.3.2 *Logistic service provider's performance management*

Another evaluating loop concerns the performance of the logistic service providers (LSPs). The important performance parameters for LSPs are:

- Lead-times of shipments
- Quality of products

In order to improve the efficiency of the supply chain around area inventory management, it is important to have constant lead-times delivered by the logistic service provider. Obviously, the quality of the deliveries must be satisfactory, because a shipment with a correct lead-time but consisting of a lot of damaged products is not acceptable. By measuring the actual lead-times and quality of shipments and comparing them with the agreed upon service levels, a performance assessment can be made. Again, monthly updates and quarterly meetings are advised (as described in the previous section concerning supplier's performance evaluation).

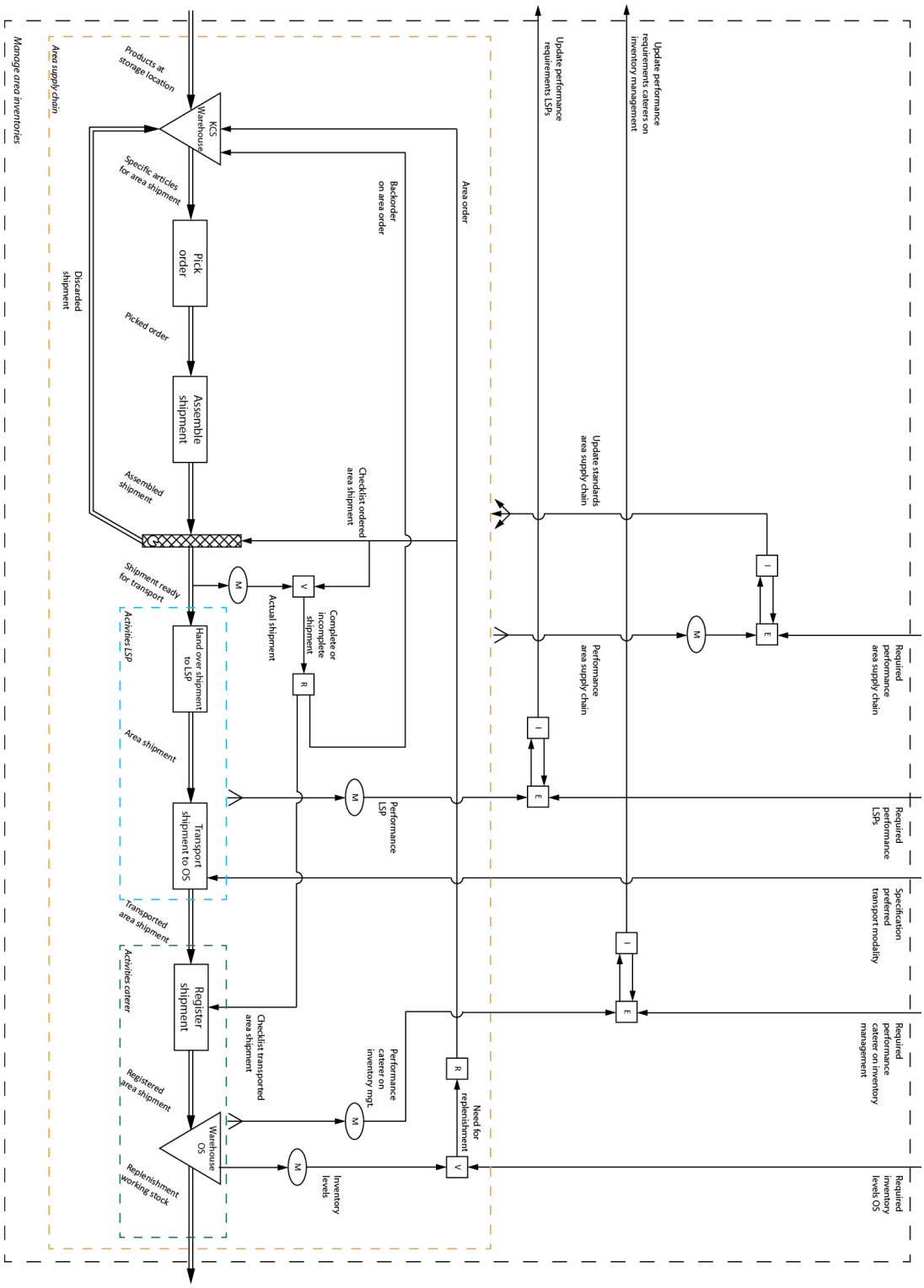

Figure 20 - Redesigned stratum 4b control model for area inventory supply chain

4.3.3.3 Caterer's performance management

One other project that is being carried out at the moment this thesis is constructed is a research into improving the monitoring and assessment of caterer performance[27]. There are main categories defined for assessing caterer performance:

- Operational inventory management
- Loading the equipment according to specification
- Food safety

Improvements of the caterer performance also lead to increased inventory reliability at outstations and reduced costs because of the reduction of failure and corresponding repair costs.

4.3.3.4 Area planner responsible for entire supply chain

The last proposed improvement is to expand the responsibilities of an area planner. By making the planner responsible for managing the performance of the entire area supply chain the different tasks are centralized. This means that the planner now becomes responsible for determining the shipment using the renewed BOM, ordering the shipment in SAP, ordering the required services of an LSP, monitoring the assembly and check of the shipment, dispatching the shipment, monitoring the transport and monitoring the registration of the arrived shipment at the outstation. The planner is given tools to optimize the different supply chains to all outstations and has overview over the chain, as opposed to only limited responsibility and overview in the present situation. This way, the planner will become more of a tactical planner instead of only an operational one. Improvements on all important performance measures are expected.

[27] MSc. thesis C. van Wijk: *Improvement of caterer performance at outstations by redesigning the control processes at KLM*, 2012.

4.3.4 *Concluding remarks on new control model*

Only the design and implementation of a new control model is not all there is to achieve a well organized, well performing distribution network for catering articles. There is more to it than only organizational issues. Four concluding remarks cover topics that need to be addressed as well.

4.3.4.1 *Improve theoretical knowledge regarding inventory- and supply chain management*

In order to make well-considered and argumented decisions concerning the distribution of catering articles, a solid understanding of the underlying theories is of great importance. To this end, the Dutch company Slimstock will provide the involved employees of NSM with a number of training sessions. Also their minor program specialized in inventory optimization will be customized to meet the needs of KLM. This minor program, however, will not be just for employees of the NSM planning department, but also for other stakeholders. The Regie-department, KCS Warehouse, suppliers and possibly logistical service providers will also be following this minor program. This brings up the next remark.

4.3.4.2 *Promote collaboration throughout the supply chain*

To achieve improvements in the entire chain, it is of vital importance to intensify the collaboration with other stakeholders. Organizing the customized minor program towards inventory optimization is one of the first steps in this direction. But also when adopting EDI and (possibly) VMI the collaboration with suppliers will have to intensify, working towards relationships that are aimed at strategic partnerships instead of only competing ones.

4.3.4.3 *Create awareness of possibilities to control processes*

By involving the employees in the process of implementing the new control model and by improving their theoretical framework, one of the most important results is that they will achieve awareness of the possibilities to control the processes they work with. By utilizing simple control loops employees will be able to assess performance and will be able to react to disturbances a lot quicker. They can work pro-actively instead of only reactively.

4.3.4.4 *Improve IT-structure to enable execution of control loops*

The current IT-structure present at CIM is not efficient. More than 10 different IT-programs are in use[28]. This makes it hard to assemble data and process it in order to assess the performance of a certain process. This fact is acknowledged by KLM and currently an extensive project called *CIMplify* is being carried out in order to improve the IT-structure. In

[28] Source: M. Groenendijk, Business Analyst IMO Inflight Services.

the new structure data collection and performance management will be much easier, but there is more to it. For instance, a subproject of CIMplify is aimed to improve the company's understanding and application of bills of material (BOMs) in order to efficiently replenish inventories at outstations.

4.3.5 Applicability of redesigned control model

Because the control model is designed from the ground up, it was not possible to benchmark the current situation and thereby being able to quantitatively support the so far purely qualitatively formulated control model. However, it is important to somehow prove that the suggested theoretical improvements are actual achievable in practice. To this end, the next chapter will contain a quantitative case study as a way show the potential results of the proposed control model.

5 Quantitative case study

The aim of this chapter is to add quantitative proof to the newly designed control model for the catering distribution network of KLM. By doing this, the relevance of the new control model becomes clear with the possible savings achievable by implementing it. Using a hypothetical *outstation X* it is possible to show how improvements on the important process criteria lead to substantial cost savings throughout the supply chain.

In the next section the important boundary conditions needed to build a relevant case are defined. Also the scope of the case study is determined and explained in the next section. Section 5.2 concerns the explanation of the current state of Outstation X, section 5.2 concerns the future state and shows a quantitative explanation of the possible improvements. The last section of this chapter shows a quick summary and overview of the achievable improvements.

5.1 Important boundary conditions and scope

5.1.1 Which part of the product portfolio to be included?

The total product portfolio, as shown in Appendix C, comprises as much as 431 products, but not all products are kept in stock at outstations. The average portfolio of products that are being kept in stock at outstation consists of around 130 different products, both disposable as well as rotable products[29]. For this case study the scope will be narrowed towards drinks. The main reason for this is that only usable data about on board consumption is available for drinks (see paragraph 5.1.4.1). This concerns water, soft drinks, beer and economy class wine. Strong liquor and business class wines are not kept in stock at the outstation; these are loaded for both the out- and homebound flight at KCS Centrum. The products that are being considered in this case study are displayed in **Table 5-1** on the next page.

5.1.2 Which type of flight will be executed?

There are a couple of flight-specific factors that also influence the determination of efficient stock levels. The consumption on a flight differs for flights with different characteristics. The most important characteristics are: (1) flight length, (2) time of day and (3) service schedule. Also the frequency of flights is important, because the more flights are executed, the more inventory is necessary in order for the caterer to do a good job. For this case study a frequency of 7 flights per week will be used; the flights are executed during daytime.

[29] Information provided by NSM Planning Department (AMS/HP).

Table 5-1 - Products included in case study

Article number	Description	Unit of measure
26002	SAINT AMAND 1,5LTR WATER	Bottle
26003	SAINT AMAND WATER 0,5LTR	Bottle
26008	SPA WATER 0,5L CREW	Bottle
26040	ALPS WATER CUP 125CC	Piece
27000	COCA COLA 33CL	Tin
27230	FANTA 33CL	Tin
27240	SPRITE 33CL	Tin
27241	SPRITE ZERO 33CL	Tin
27242	SCHWEPPES GINGER ALE 33CL	Tin
27243	SCHWEPPES SODA WATER 33CL	Tin
27244	SCHWEPPES TONIC 33CL	Tin
27250	NESTEA 33CL	Tin
27303	ORANGE NECTAR KRINGS 1.0LTR	Pack
27312	APPLE NECTAR KRINGS 1.0LTR	Pack
27332	TOMATO JUICE KRINGS 1.0LTR	Pack
27451	PERRIER SPR. MIN. WATER 33CL	Tin
27470	COCA COLA LIGHT 33CL	Tin
27471	COCA COLA ZERO 33CL	Tin
27751	SPA WATER 1,5LTR CREW	Bottle
53979	MCL TERRA ANDINA RED WINE	Bottle
53980	MCL TERRA ANDINA WHITE WINE	Bottle
54581	HEINEKEN BEER 25CL	Tin

5.1.3 *Which type of plane should be used?*

KLM operates different sorts of planes with corresponding different configurations concerning maximum number of passenger it can carry. Logically, the type of aircraft that is being operated on flights to and from outstation X is of influence on the required inventory levels. Table 5-2 shows the different types of aircraft used for ICA-flights and their corresponding seat capacities. For this case study a Boeing 747 – 400 combi is used.

Table 5-2 - Aircraft types with corresponding capacities

Aircraft	Business Class seats	Economy Class seats	Total seats available
Boeing 777 - 200	35	283	318
Boeing 777 - 300	35	390	425
Boeing 747 - 400	42	373	415
Boeing 747 - 400 combi	42	233	275
Airbus A330 - 200	30	213	243
Airbus A330 - 300	30	262	292
McDonnel Douglas MD11	24	261	285

5.1.4 *Which data should be used?*

Two types of measured data are needed in order to draw conclusions on desired stock levels. The first type is measurements and analysis on the average consumption per passenger; the second type is data concerning the actual passenger numbers on flights from outstation X to Amsterdam.

5.1.4.1 *Consumption data*

Gathering data about on board consumption has proven to be difficult at KLM. In March 2012, extensive effort has been put into gathering data on EUR-flights. The reason to choose for data collection on EUR-flights was of the simplicity of loading, the equipment for these flights is only loaded at KCS Centrum. However, because of the *galley-galley loading*, there are no outstations for EUR destinations. This is the main reason that this case study has a hypothetical character; outstation X is defined and data from the EUR-countings is used to model the consumption on the flights from outstation X.

5.1.4.2 Passenger data

Gathering data about the number of passengers on each flight is much easier. This data is automatically generated, because a meticulous administration of the exact number of passengers on each flight is very important. Not only to monitor revenues, but also for reasons concerning flight safety. For this case study, passenger numbers from the first eight months of 2012 are used to calculate the average passenger occupancy on ICA-flights[30]. **Table 5-3** shows the number of passengers, the number of seats and the corresponding occupancy for both the Business – and the Economy Class. It can be seen that the ratio between CCL- and MCL-passengers is about 1:10. This shows that from a logistical point of view, the group of economy passengers is more important because this forms the largest part of the total inventory present at an outstation.

Table 5-3 - Average PAX occupancy and profit per PAX

	PAX [#]	Seats [#]	Occupancy [%]
Total uplift	10.479.654	12.222.064	86
Business Class (CCL)	976.759	1.351.173	72
Economy Class (MCL)	9.502.895	10.870.891	87

5.1.5 Which service levels must be assigned?

In this context a service level is defined as the desired level of satisfying a passenger (customer) with his/her first choice for a product during a service on board[31]. Differences in service levels obviously exist between passengers travelling Business Class versus passengers travelling Economy Class. However, when writing this case study, no actual service levels are agreed upon yet. After deliberation with Product Management, artificial and desired values will be used, being: a service level of 90% for MCL-passengers and a service level of 100% for CCL-passengers. The latter is by definition unachievable, but this is how PM would like to see it; fact is that CCL-passengers should be satisfied with their first choice as much as possible. An important note is that this service level applies to the products that are offered on board; a passenger requesting a product that is not in the portfolio is still considered to have an acceptable service level when his choice for a product of the menu is directly satisfied. However, to achieve the highest customer satisfaction trends in passenger wishes should be closely monitored and the portfolio should be updated according to these trends.

[30] Data acquired with help of Controlling Department (SPL/OO) of Inflight Services.

[31] Defined in collaboration with the department Product Management (SPL/NY).

5.2 Current state for outstation X

This paragraph is aimed to translate the boundary conditions that were set in the previous paragraph into measurable units in order to assess the possible improvements.

5.2.1 Financial value of stock in area supply chain

5.2.1.1 Value of stock present at outstation X

The total financial value of drinks in stock at outstation X can be calculated. **Table 5-4** on the next page shows an overview of the total number of articles used for this case study including their financial value. Assuming a rather constant demand for products on each flight, the theory behind inventory management states that the EOQ-model can be applied. This states that the average amount of products in stock is Q/2 with Q being the normal stock level in this case[32].

In the current situation taking four weeks of consumption and adding three weeks of consumption to that as safety stock levels determine the total stock levels. This staggering high safety stock of 75% is being installed because there is no recent and accurate knowledge about on board consumption, there is no accurate knowledge about passenger forecasts and the lead-time of the LSP is not constant. In summary this means that the average value of the inventory at outstation X during a four-week replenishment cycle is:

*(Q/2 + safety) * cost price =* **€ 4.755,33**.

5.2.1.2 Value of stock in pipeline to outstation X

Outstation X is considered to have a transportation lead-time of 50 days for sea freight, with this OS X is considered to have an average transportation lead time. With a replenishment cycle of four weeks, this means that on average there is 50/28 = 1,8 shipment in transport at any given time. A shipment carries the new supplies for four weeks consumption, therefore the average value of stock in the pipeline is:

*1,8 * normal stock level * cost price =* **€ 6.848,93**

Then the total financial value of stock in the area supply chain becomes:

Value of stock at OS X + value of stock in pipeline = **€ 11.604,25**

[32] R.J. Tersine, *Principles of Inventory and Materials Management*, pp. 92.

Table 5-4 - Current stock levels including price at outstation X

Art. no.	Description	Unit	Stock lvl	Safety lvl	Value /prod.	Total value
26002	SAINT AMAND 1,5LTR WATER	Bottle	1600	1200	€ 0,123	€ 221,40
26003	SAINT AMAND WATER 0,5LTR	Bottle	1920	1440	€ 0,082	€ 275,52
26008	SPA WATER 0,5L CREW	Bottle	240	180	€ 0,197	€ 82,74
26040	ALPS WATER CUP 125CC	Piece	6000	4500	€ 0,048	€ 504,00
27000	COCA COLA 33CL	Tin	2000	1500	€ 0,213	€ 745,50
27230	FANTA 33CL	Tin	400	300	€ 0,213	€ 149,10
27240	SPRITE 33CL	Tin	667	500	€ 0,213	€ 248,57
27241	SPRITE ZERO 33CL	Tin	134	100	€ 0,213	€ 49,84
27242	SCHWEPPES GINGER ALE 33CL	Tin	64	48	€ 0,200	€ 22,40
27243	SCHWEPPES SODA WATER 33CL	Tin	64	48	€ 0,200	€ 22,40
27244	SCHWEPPES TONIC 33CL	Tin	400	300	€ 0,200	€ 140,00
27250	NESTEA 33CL	Tin	96	72	€ 0,324	€ 54,43
27303	ORANGE NECTAR KRINGS 1.0LTR	Pack	1120	840	€ 0,500	€ 980,00
27312	APPLE NECTAR KRINGS 1.0LTR	Pack	320	240	€ 0,450	€ 252,00
27332	TOMATO JUICE KRINGS 1.0LTR	Pack	854	640	€ 0,480	€ 717,12
27451	PERRIER SPR. MIN. WATER 33CL	Tin	267	200	€ 0,220	€ 102,74
27470	COCA COLA LIGHT 33CL	Tin	400	300	€ 0,213	€ 149,10
27471	COCA COLA ZERO 33CL	Tin	96	72	€ 0,270	€ 45,36
27751	SPA WATER 1,5LTR CREW	Bottle	174	130	€ 0,338	€ 102,75
53979	MCL TERRA ANDINA RED WINE	Bottle	1334	1000	€ 0,330	€ 770,22
53980	MCL TERRA ANDINA WHITE WINE	Bottle	667	500	€ 0,330	€ 385,11
54581	HEINEKEN BEER 25CL	Tin	1400	1050	€ 0,210	€ 514,50

5.2.2 *Non-performance transportation costs*

In the first eight months of 2012 a grand total of € 532.222,11[33] is spent on repair shipments by air to stations that normally are replenished with sea freight. This means that on average a combined total of € 15.206,35 is spent every week for all sea-stations. With 42 sea-stations and a four-week cycle this means that on average € 1.448,22 is spent on non-performance transportation costs for outstation X in every replenishment cycle, summing up to € 18.826,90 per year. In total 538 repair shipments were sent in the first eight months, resulting in an average of 1,05 repair shipments per replenishment cycle per station.

5.2.3 *Transportation costs*

The regular transportation costs that are spent on replenishing the stock levels at outstation X are based on the fare that the LSP bills to KLM. In July 2012 the average price for shipping a 20' container with Kuehne & Nagel was € 2.900,42 and for shipping a 40' container the average price was € 3.863.33[34]. This means that the total normal transportation costs per year for outstation X will be € 37.705,46 when sending 20' containers and € 50.223,33 when sending 40' containers. Appendix G shows a detailed overview of the transportation costs per container per outstation.

5.2.4 *Ratio between business class and economy class*

The used aircraft for this case study is a Boeing 747 – 400 combi; with a maximum number of passengers of 275; the frequency of flying was 7 flights per week (1 flight every day of the week). The theoretical ratio between business class seats and economy class seats on this aircraft is 42 : 233, which is equal to 1 : 5,5. It is important to realize that this ratio concerns seats, not actual *occupied* seats. For the future state it is important to discern between stock for business class and stock for economy class.

In the current state this would mean that $1/6,5$ part of the stock is reserved for business class seats and $5,5/6,5$ part of the stock is reserved for economy class seats. Service levels are not taken into account, because in the current situation this is also the case. Also, this ratio between economy- and business class seats is the smallest of all aircrafts, meaning that for other types of aircrafts the possible savings are even bigger (a larger part of the stock is reserved for economy class, therefore bigger savings can be made).

[33] Source: KPI dashboard NSM Planning Department (AMS/HP).

[34] Source: Department of Customs Affairs and Distribution (SPL/HI).

5.3 Future state of outstation X

In this paragraph the practical benefits of implementing the new control model for the distribution network are described. Based on measured consumption data and passenger data the distribution network can be operated more efficiently, resulting in potentially happier passengers and at the same time leading towards substantial possible cost savings.

5.3.1 Optimize normal stock levels

In order to optimize the normal stock levels the acquired data on onboard consumption and data on passenger occupancy are used. For all the articles used in this case study the consumption has been measured and analyzed. Then the consumption per flight can be compared to the passenger occupancy resulting into the average consumption per passenger per flight. In this case the consumption

In order to show how this reasoning works in practice, an example will be given covering the red wine in economy class. Consumption data about red wine during daytime on flights from outstation X is shown in Figure 5-1. The average consumption is 27,2% of the total number of bottles that are loaded. The passenger occupancy for the economy class is 87%, meaning that the average consumption with a full aircraft would be 31,2%.

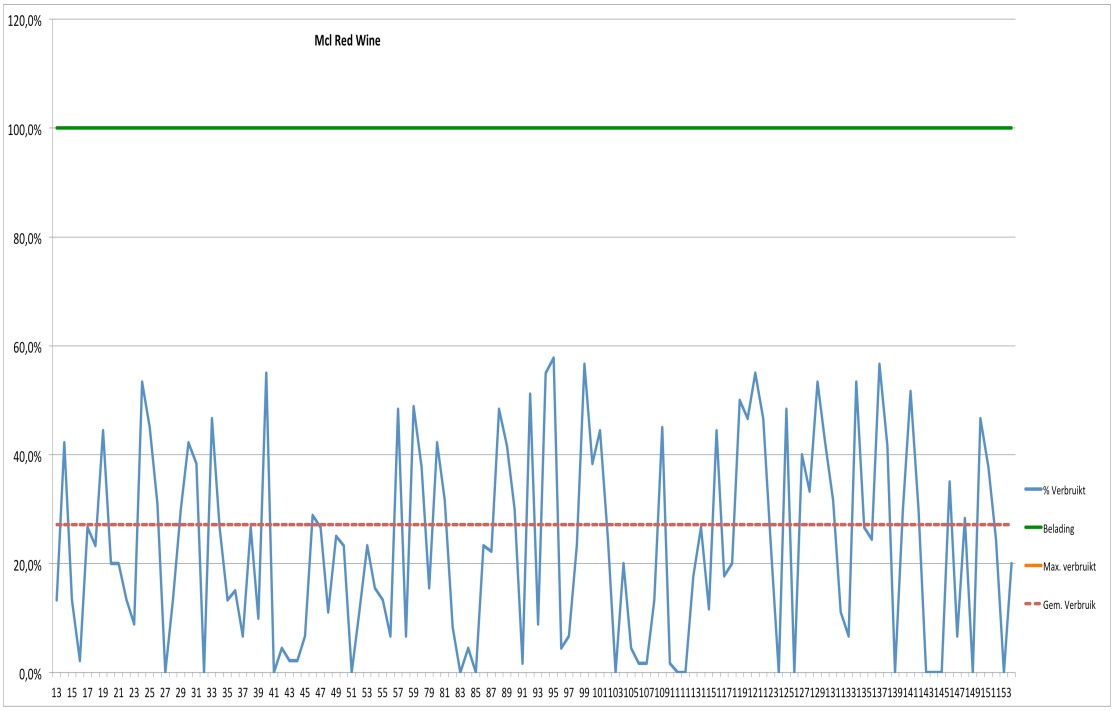

Figure 5-1 - Consumption of red wine in economy class during daytime flights

Based on this data, the new loading degree can be determined. The service level for economy class wine is set to 90% on the first choice, with only one possible substitute (economy class white wine). There is one important factor that needs to be taken into account as well, being the fact that KLM uses a method of using equipment on board to optimize the number of cabin attendants needed on a flight. This is called work-methodic loading and has the consequence that similar trolleys are built for use in different galleys. This automatically means that the loading degree should be higher due to losses to ensure the work-methodic loading. Considering the service level and this restriction the proposed new loading degree would be 65% instead of 100%. This means that the normal stock level for economy class red wine can be lowered with 35%. The same method applies to all the other articles, resulting in the proposed new inventory levels shown in Table 5-5 below.

Table 5-5 - Old and new normal stock levels at outstation X

Article no.	Description	Unit	Old stock lvl	Diff.	New stock lvl
26002	SAINT AMAND 1,5LTR WATER	Bottle	1600	- 25%	1200
26003	SAINT AMAND WATER 0,5LTR	Bottle	1920	- 25%	1440
26008	SPA WATER 0,5L CREW	Bottle	240	- 100%	0
26040	ALPS WATER CUP 125CC	Piece	6000	- 15%	5100
27000	COCA COLA 33CL	Tin	2000	- 38%	1250
27230	FANTA 33CL	Tin	400	- 60%	160
27240	SPRITE 33CL	Tin	667	- 38 %	417
27241	SPRITE ZERO 33CL	Tin	134	- 60%	54
27242	SCHWEPPES GINGER ALE 33CL	Tin	64	- 60%	26
27243	SCHWEPPES SODA WATER 33CL	Tin	64	- 60%	26
27244	SCHWEPPES TONIC 33CL	Tin	400	- 38%	250
27250	NESTEA 33CL	Tin	96	- 60%	38
27303	ORANGE NECTAR KRINGS 1.0LTR	Pack	1120	- 15%	952
27312	APPLE NECTAR KRINGS 1.0LTR	Pack	320	+ 30%	416
27332	TOMATO JUICE KRINGS 1.0LTR	Pack	854	- 10%	769
27451	PERRIER SPR. MIN. WATER 33CL	Tin	267	- 38%	167
27470	COCA COLA LIGHT 33CL	Tin	400	- 38%	250
27471	COCA COLA ZERO 33CL	Tin	96	- 60%	38
27751	SPA WATER 1,5LTR CREW	Bottle	174	- 100%	0
53979	MCL TERRA ANDINA RED WINE	Bottle	1334	- 35%	867,1
53980	MCL TERRA ANDINA WHITE WINE	Bottle	667	- 40%	400,2
54581	HEINEKEN BEER 25CL	Tin	1400	- 20%	1127

There are three important remarks: (1) a number of products are served in both the economy- and business class. For both classes the new normal stock level has been calculated and summed to form the total new stock level[35]. (2) For one product the inventory level should be increased because the consumption data showed that often there was not enough apple juice on board to meet the demand. (3) Crew will be drinking the same type of water as the passengers; therefore no more Spa water is necessary.

5.3.2 Decrease safety stock levels

Because more efficient load plans for the catering load are developed based on passenger and consumption data and because the performance of the logistics service providers is tightly monitored and improved; it is a logical step that the safety stock levels can be decreased as well. The before mentioned factors, load plans and LSP performance, ultimately led to the very high safety percentage of 75% of 4 weeks usage.

Reduction of safety levels has been discussed with the planners and the manager planning, resulting in the following results. Initially, to stay on the safe side the safety levels could be lowered from three weeks to two weeks. However, this would still mean a safety level of 50% of four weeks usage. When the performance of the distribution network is really improved and uncertainties are kept to a minimum, a decrease in safety levels to one week would be acceptable as well. In total, the safety levels would decrease with either 33,33% or in the preferable latter case with 66,67%.

5.3.3 Decrease non-performance transportation costs

Another direct consequence of improved controllability of the distribution network is the fact that the non-performance costs will decrease, because the reliability of the inventory at outstation X has risen to a satisfactory level. Also for the calculation of the reduction of repair shipments a discussion with the planning department was held. A satisfactory level of repair shipments would be a maximum of one in every three cycles, going to maximum 0,33 repair shipments per cycle and a total of maximum 4,33 repair shipments per year per outstation.

This is a reduction of 68% of the number of repair shipments sent to outstation X. This results in a drop of costs from on average €1.448,22 per cycle to €463,43 per cycle and a yearly total of on average €6.024,59. When this result is extrapolated to all outstations the amount of non-performance transportation costs spent on a yearly basis would drop from €790.729,99 to € 253.033,60.

[35] The passenger occupancy ratio between business- and economy class was 1:10; therefore one-tenth of the stock was dedicated to ccl PAX and nine-tenth to mcl PAX.

5.3.4 *Decrease transportation costs*

The regular transportation costs are not necessarily decreasing as a consequence of the described improvements. This only is the case when the products that are not within the scope of this case study show similar possibilities for improvements, thereby decreasing the transportation volume so much that the transfer from a 40' to a 20' container can be made.

By decreasing the total volume of beverages in the amounts mentioned in this case study, this transition will not become reachable. Beverages sum up to 28% of the total volume that is shipped to outstation X[36], because of the improvements this volume can be lowered with 26%. Thereby the total shipment volume decreases with 7,18%, which is not enough to go from a 40' container to a 20' container.

Assuming that the other parts of the shipped products also show significant potential to decrease the volume, the transition from 40' to 20' can be made. This would result in a yearly cost saving of €12.517,87 for outstation X.

5.3.5 *Other savings*

The above-mentioned savings all have a direct link to the distribution of catering articles. However, there are other savings to be achieved that are not directly linked to the transportation of products. The first example is the saving on on-board weight. Because the catering load can be optimized to meet the specific requirements of a specific flight, the oversupply of catering articles on board is decreased. This has a positive effect on the DOW factor, leading toward substantial cost savings (less fuel needed, more cargo volume available etc.). The records indicate that one kilogram of DOW-saving equals a cost saving of €15.000 per year for ICA-flights[37].

Another example of potential savings with no direct-link to distribution is the possibility to decrease environmental impact by decrease of shipped volume and weight. Although on the yearly total of globally shipped containers (in 2010 538.283.754 TEU (Twenty feet Equivalent Unit) were shipped throughout the world[38]), the influence of KLM may be small, but for a company with a very active CSR-policy it is important to mention.

[36] Source: Research done by R.J.M. Janssen [2011].

[37] Source: Controlling Department of Inflight Services (SPL/OO).

[38] Source: http://data.worldbank.org/indicator/IS.SHP.GOOD.TU/countries/1W?display=graph , last checked on September 21st, 2012.

The last factor is the increased service to passengers due to personification of the catering load. By doing this, the *repurchase intention*, a mean to show the passenger's satisfaction and the likelihood that he/she will travel with KLM again, will be improved. Accurate data for this factor could not be acquired.

5.4 Summary of possible savings

This last paragraph of this chapter shows a quick summary of the achievable results with the renewed control model for the catering distribution network. The possible savings per replenishment cycle for outstation X are shown in Table 5-6.

Table 5-6 - Possible savings per replenishment cycle for outstation X

Factor	Old level	New level	Difference
Average value of beverage inventory at outstation X per cycle	€ 4.755,33	€ 2.310,00	- 51%
Average number of beverage products in stock at outstation X per cycle	10.108	7473	- 27%
Average value of beverage inventory in pipeline per cycle	€ 6.848,93	€ 4.987,87	- 27%
Average non-performance transportation cost per cycle	€ 1.448,22	€ 463,43	- 68%
(Normal transportation costs)	(€ 3.863,33)	(€ 2.900,52)	(- 25%)

These results look very promising, showing a large decrease of the financial value of the inventory in the supply chain around outstation X as well as a steep decrease of the non-performance transportation costs associated with repair shipments. There is also a possibility to substantially lower the normal transportation costs, but this is depending on the savings potential of the other products in the portfolio that are outside the scope of this case study.

When the results for outstation X are extrapolated to approximate possible results for the entire area supply chain the total potential savings for KLM become more apparent. In total there are 58 outstations in use in September 2012. Also, the total average weight that can be saved per flight becomes 90,7 kilogram; this is used for the DOW-savings. The results are shown in the Table 5-7.

Table 5-7 - Possible savings for entire area supply chain

Factor	Current situation	New situation	Saving
Avg. value of beverage inventory	€ 673.046,71	€ 423.276,77	€ 249.769,95
Avg. non-performance transportation costs	€ 1.091.957,88	€ 349.426,22	€ 742.531,66
DOW-savings	-	-	€ 1.360.595,89
TOTAL SAVINGS (without regular transp. savings)			**€ 2.352.897,50**
(Regular transportation costs)	(€ 2.912.950,82)	(€ 2.186.992,08)	(€ 725.958,74)
TOTAL SAVINGS (with regular transp. savings)			€ 3.078.856,24

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6 Conclusions and recommendations

This research was aimed to develop a new control model for the worldwide distribution network of catering articles of KLM. The goal with the new control model is for KLM to be able to operate their distribution network more efficiently and to be more aware of choices to be made concerning inventory management, transport etc.

The distribution network is divided into a central part and an area part. The central part is concerned with the inventory management and corresponding supply chain for the central warehouse at Schiphol Noord. The area part is concerned with the inventory management and corresponding supply chain of the 58 outstations KLM operates all over the world.

The analysis of the current distribution network showed that on the operational level the processes were logically shaped. However, there was almost no form of process- or function control established which had the consequence that it is not possible to objectively assess options and no objective conclusions on performance could be drawn.

The analysis also showed that there was a lack of two important boundary conditions. This concerned the lack of knowledge about the on board consumption of catering articles by passengers and the lack of clearly defined normative standards that should be used to define and assess desired performance levels.

Another important conclusion based on the analysis is that there it became apparent that there is a strong need for extra theoretical training for the employees involved in the distribution network. In order to improve a process, it is important that people thoroughly understand how the process works, in this case theoretical knowledge about inventory management and supply chain management can (and should) be increased.

Based on the three important performance criteria as defined by KLM, being (1) the reliability of the inventory, (2) the quality and (3) the costs involved; the new control model was designed. The performance criteria were translated into measurable *key performance indicators* and the control model focuses on making sure these KPIs can be measured, evaluated and when necessary influenced.

By executing a case study to quantitatively support the new design, it was shown that significant savings could be realized. For the entire area supply chain as much as € 2,3 million could be saved, while improving the reliability of the inventory and the quality. However, it should be noted that this potential is still hypothetical, not enough data was currently present to present this as definite savings.

Three recommendations should be added to these conclusions. The first is that the collaboration of the NSM department with both the Product Management department and the Procurement department should be improved. Currently, the NSM department does not get involved enough in development processes that could have large influences on the logistics and inventory management. The two departments, Product Management and Procurement should feed NSM with clear normative standards. These standards must be developed, again in collaboration with NSM.

The second recommendation is that knowledge about the customer's preferences concerning catering articles should be gained fast. This is of vital importance for KLM's vision to serve passengers in a more personal fashion, thereby working towards becoming the world's best service oriented airline. It is also very important from a logistical point of view, because the actual stock levels and the supply chain management for the outstations is build around knowledge about onboard consumption.

The third and last recommendation is to investigate the promising possibilities to substantially improve the central part of the distribution network by seeking more collaboration with suppliers on the field of inventory management. The possibilities for a VMI-system in combination with EDI have been described briefly in chapter four. It is recommended to make a thorough assessment of the possibilities, advantages and risks; this would make a nice graduation project in itself.

The final remark for this thesis is that the parties involved in the distribution of catering articles should be aware of their role in the bigger picture, their possibilities to influence processes and the need for collaboration to make important improvements throughout the entire distribution network. Good communication, trusting each other and the urge to become better can initiate a process where KLM's Cabin Inflight Management will make the transition from an entity that, aware or unaware, followed and obeyed others in directing their supply chain into a strong coordinating director of their own catering supply chain, promoting cooperation and collaboration between involved parties in the entire chain!

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Formal interviews with KLM employees

1.	**M. Baldee**	Manager Contract Management
2.	**T. Berghmans**	Area Planner a.i.
3.	**A. Bouwhuis**	Program Manager CIM
4.	**I. Bocken**	Head of NSM Regie
5.	**V. Brethouwer**	Manager Loading & Ordering
6.	**A. Brinkman**	Supply Chain Specialist

7.	**M. Broertjes**	Product Specialist EUR
8.	**A. Buskermolen**	Controller CIM
9.	**H. Christiaans**	Central Planner
10.	**A. Claessen**	Product Manager EUR
11.	**P. van Dijk**	Supply Chain Specialist
12.	**A. van Driel**	Central Planner a.i.
13.	**S. Dubelaar**	Manager Planning NSM a.i.
14.	**S. Eelman**	Employee Loading & Ordering + Microsoft Access expert
15.	**M. Groenendijk**	Business Analyist IFS
16.	**E. Gerrits**	Central Planner a.i.
17.	**R. Hoffschlag**	Assistant Custom Affairs
18.	**A. Joosten**	Director NSM
19.	**B. Kroes**	Head of Operations NSM
20.	**M. de Nood**	Product Manager WBC
21.	**M. Paelinck**	Senior consultant Decision Support
22.	**E. Polhuijs**	Vice-President CIM
23.	**P. Roos**	Area Planner
24.	**M. Tempels**	Area Planner
25.	**S. van Veen**	Contract Manager Suppliers
26.	**R. van Waart**	Director Crew Products & Operations
27.	**T. Werkhoven**	Contract Manager KCS

Formal interviews with non-KLM employees

1.	**R. van den Berg**	Consultant	(Access to Quality)
2.	**J. Bakkers**	SAP Project Manager	(ORTEC)
3.	**M. Brandjes**	Senior Manager Business	(ORTEC)
4.	**A. Kolk**	Manager Warehouse	(KCS B.V.)
5.	**W. Ploos van Amstel**	Supply Chain Expert	(Slimstock)
6.	**W. Provoost**	Director Customer Services	(KCS B.V.)
7.	**W. Verbakel**	Supply Chain Director	(KCS B.V.)
8.	**M. Winter**	Director Slimstock Professionals	(Slimstock)
9.	**C. Worm**	Unit Manager	(KCS B.V.)

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Appendices

Redesign of the Control Model of the Catering Distribution Network of KLM

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Abstract— **This document is the summarized result of a MSc. thesis [1] with the subject of improving the control model for the worldwide catering distribution network of KLM. The thesis is aimed to realize improvements in the ways to objectively assess en influence the performance of the distribution network and realize cost savings. The new design of the control model is quantitatively backed up with an extensive case study, showing improved controllability can potentially lead to cost savings of magnitude around 2.5 million euros.**

Keywords— **Airline Catering, Supply Chain Management, Logistics, Systems Thinking, Controllability, Performance Management, Inventory Management, Warehousing**

I. Introduction

The current airline industry is a very competitive market due to heavy pressure on profit margins due to ever climbing fuel prices and fierce competition. As part of Europe's largest airline group AIR FRANCE KLM, KLM is constantly looking for possibilities to improve passenger satisfaction and yet struggles with the corresponding necessity for cost savings in order to keep profits up to acceptable levels.

For KLM, being a full-service carrier, an important part of the overall customer experience, is the on board inflight service that is offered. In its turn, the catering forms a substantial part of the total inflight service. On every flight, a certain catering product is offered to each passenger, based on the predetermined service schedule for that flight. Because of the fact that for the intercontinental destinations it is impossible to take the entire catering load for the outbound- and the homebound flight on the outbound flight, there is a need for local replenishments.

This paper is divided in six main sections. This is the last paragraph of the first section, being merely an introduction. The second section is aimed to clarify all the relevant topics that are concerned with catering and the corresponding distribution network at KLM. The third section shows the problems that emerged during analysis of the current situation. The fourth section is aimed to clarify the new control model, including important performance indicators. The fifth section encompasses a quantitative case study in order to back up the qualitative new control model. The sixth and last section contains the important conclusions and recommendations based on the previous five sections.

II. Catering at KLM

In this section the different aspects of on board catering at KLM are being explained, including the distribution network that is laid out to facilitate the loading of the flights at the required locations.

A. Why Catering

One of the goals of KLM is to become the best service oriented airline in the world. On board catering, including all products used for service ranging from headphones to food and drinks, forms a very important part of the strategy towards this goal.

B. Process Steps

The six different steps of the catering process are described below. Every catering product that is within the portfolio follows these steps. The daily fresh foods and drinks are not within the scope of this paper.

1) Product Development: Three different product groups are defined, each with different demands for service levels, sorts of products etc. These product groups are: World Business Class (WBC), intercontinental economy class (ICA-M) and the European product group (EUR).

This step is concerned with determining *what* should be served to the passenger, both for food- as well as for non-food products in order to maximize the customer satisfaction.

2) Product Ordering: After developing a product, the product must be produced and supplied to KLM. In order to do this, first a supplier must be selected. Then, the planning department of Network Supply Management is responsible for the operational execution of ordering and controlling the inventory of a product using the IT-system SAP.

3) Product Delivery and Storage: The supplier processes the order and is supplied with a time slot for the desired delivery date. The driver calls in at the warehouse; the shipment is checked and then registered in SAP. SAP provides the location where the products should be placed in the warehouse and the planning department sees the updated inventory values in SAP.

4) Product Loading: The next step in the process is loading the equipment of the flight with the required products. To this end, the articles must be transported from the central warehouse to the location where the flight must be loaded. The different sorts of catering (food, drinks, dry goods) are loaded into the equipment (trolleys, boxes) and assembled to form the complete catering load for a specific flight.

5) The Flight: This is the most important step in the process. All the efforts in the steps before or after this one are being carried out to make sure that the passengers will get the desired catering products on their flight.

The evaluation of the catering products that passengers get offered during a flight forms an important factor in the overall satisfaction rate and so it is very important to have the right products in the right amounts on board. But at the same time KLM wishes to maximize its profit on a flight and therefore it is important to make sure that not too many products are put on board. The importance of knowledge of on board consumption becomes evident.

6) Product Unloading: When the flight has landed and all the passengers have safely disembarked, all the catering equipment is taken off board and transported back to the caterer. The products can be categorized in three different groups: waste products, products for regeneration and products for cleaning.

Waste products are product carriers of used consumables and leftover food and drinks. Products for regeneration are unused products that can be loaded again into another trolley for another flight. Products for cleaning are used rotable products that can be used again after cleaning them.

After completion of this step, the process of getting a product on board to serve the passenger is completed Steps 2 until 6 will repeat until the particular product is taken out of the product portfolio.

C. EUR vs. ICA

The six steps that were explained above, explain the general process of a catering product for a EUR-flight. The first step is always the same, whether the product is developed for a EUR- or an ICA-flight. However, there are some important differences or required additions concerning steps 2, 3, 4 and 6 on ICA-flights.

For EUR-flights, with a considerably shorter flight time than ICA-flights, it is possible to load the catering equipment for both the outbound and the homebound flight at Schiphol. This is called galley-galley catering. For ICA-flights, however, this is not possible because there is not enough storage space in the aircraft's galleys and the freshness of the food will not be according to quality regulations. This means that the catering load for the homebound flight must be loaded at the destination itself. Therefore KLM has contracts with local caterers at the destinations where this is required.

1) Outstations: KLM does not have a contract with a caterer at every destination the airline has in its network. The destinations at which KLM has a caterer are called outstations. On the grand total of 71 ICA destinations there are 58 destinations designated as outstations and the other 13 are simply destinations.

The catering handling of a flight is now separated in the handling of the outbound flight by KLM Catering Services (KCS) at Schiphol and the handling of the homebound flight by the caterer at the outstation. KCS loads the outbound flight, the caterer does the unloading of the outbound flight, the caterer loads the homebound flight and KCS does the unloading of the homebound flight.

Obviously the caterer needs its own supply of KLM catering products in order to be able to load the products onto the homebound flight. KLM has chosen to organize the distribution of these products by having a central warehouse (KCS Warehouse) where all their suppliers deliver all their products after which the distribution of the specific articles per outstation is originated from there. For the distribution three different transport modalities can be used: sea freight, airfreight or pantry outfits. A schematic overview of the catering distribution network of KLM is depicted in Fig. 1.

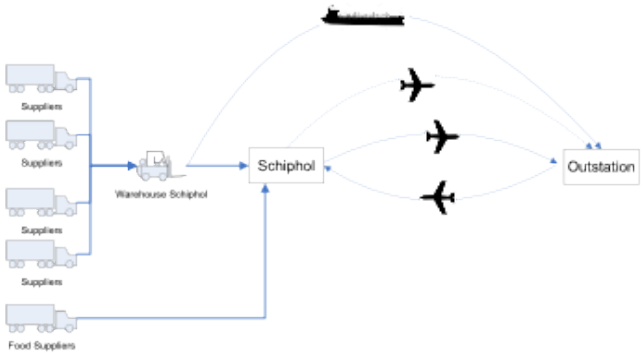

Fig. 1 Catering Distribution Network of KLM

2) Sea freight: This is the preferred transport modality for the distribution of catering products by NSM. The reason for this is that sea freight is a lot cheaper than the other two modalities. A comparison shows that for KLM transporting sea freight costs on average € 0,01 per ton-km versus € 0,10 per ton-km for transporting airfreight. Most outstations are supplied by using sea freight through a logistics service provider, Kuehne & Nagel. The total number of outstations that are supplied by sea freight is 42; a schematic overview for these ICA-stations is presented in Table 1 on the next page.

TABLE I
OUTSTATIONS SUPPLIED WITH SEA FREIGHT

	REGION				
	Africa	**APAC**	**CSA**	**MESA**	**NAD**
AIRPORT CODE	ACC	BKK	BON	None	ATL
	CPT	CTU	CUR		DFW
	DAR	DEL	EZE		IAD
	JNB	HGH	GIG		IAH
	LND	HKG	HAV		JFK
	LOS	ICN	LIM		LAX
	NBO	KIX	PBM		ORD
		KUL	PTY		SFO
		MNL			
		NRT			
		BJS			
		PVG			
		SIN			
		TPE			
		XMN			

3) Airfreight: There are a number of reasons why sea freight is not possible and another transport modality has to be chosen. Then airfreight is next in line. These reasons are:

- Customs problems at the destination port,
- The outstation is not (or very hard) reachable by sea,
- The volume of products to send to a outstation is so low, that it is impossible to fill a sea container up to an acceptable level,
- Emergency shipments that require a shorter lead-time than the shortest possible lead-time that can be achieved by sea freight.

Only in these cases airfreight is preferred over sea freight, which is executed by another logistics service provider (Blue Crown). The total number of outstations that are being supplied with airfreight is 19; a schematic overview for these ICA-flights is depicted in Table 2.

TABLE II
OUTSTATIONS SUPPLIED WITH AIRFREIGHT

	REGION				
	Africa	**APAC**	**CSA**	**MESA**	**NAD**
AIRPORT CODE	ADD	CGK	AUA	ALA	MEX
	CAI		GRU	AUH	
	EBB		GYE	BAH	
	LUN		UIO	DMM	
				DXB	
				KWI	
				MCT	

4) Pantry outfit: This transport modality is only used as a way to repair emergencies. When there is a sudden need for a small number of important articles at an outstation, for example a product without which the flight is not allowed to depart, a small number of products can be transported to the outstation on the outbound flight. There is designated room for these so called pantry outfits on every flight. Because of the highly disturbing character with respect to the normal distribution process, the use of pantry outfits minimized.

III. PROBLEMS IN CATERING DISTRIBUTION NETWORK

This section is used to summarize the identified problems based on thorough analysis by using the Delft Systems Approach [2] and theory about control developed by In 't Veld [3] and Bikker [4].

The distribution network is divided into a central part and an area part. The central part is concerned for the inventory management and corresponding supply chain of the central warehouse. The area part is concerned with the inventory management and corresponding supply chain of the outstations.

A. Overall problem for entire network

For the entire distribution network one major setback can be spotted. This concerns the lack of a control loop in order to gain knowledge about the on board consumption of catering articles. In order to become the best service oriented airline in the world, KLM must be able to offer passengers on different flights different sorts of services depending on destination, type of passengers, time of day and flight length.

The lack of structural information about on board consumptions has four important consequences:

- It is not possible to offer flight-dedicated services. This means that KLM cannot fulfill the needs of different sorts of passengers on different sorts of flights,
- The area planning department lacks valuable knowledge in order to optimize their inventory management of outstations,
- There is no knowledge about the performance of a catering load on a flight. The measured consumption on EUR-flights shows that on a lot of flights there is a structural overload of articles, resulting in structural higher operating expenses for the company,
- Because of structural overloading, the total inventory level in the distribution network is higher than necessary. This also adds to the operational costs, resulting in declining yields.

B. Specific problems for central part of the network

For the central part of the distribution network, a total of four specific problems have been identified.

1) Shortage of theoretical knowledge about inventory management: The planners work with SAP and in order to understand the system and for instance the order advices it produces, it is important to have a clear understanding of the theory of inventory management. Unfortunately, the planners do not have extensive knowledge on this subject. The consequences are that the effectivity and productivity of the planners are not as good as they could be.

2) No standardized information sharing with suppliers: There are no strict guidelines concerning the way of communicating with suppliers. This causes problems in a two possible ways:

- Suppliers are not required to send an order confirmation; therefore there is no definitive knowledge about the order being accepted or not.
- Order information is mainly exchanged by e-mail to specific persons. When this person is not in the office

for a longer period of time, the supplier will not process the order while KLM is not aware of this fact.

3) Differences between SAP values and actual stocks: When the operators at KCS Warehouse register a delivered shipment in SAP, the system automatically assigns optimal storage locations to the different products. It is then the responsibility of the operators to place the products at their assigned storage location. This does not always happen, but there is no feedback mechanism to check it. This means that discrepancies between the digital information and the actual location of inventories arise. Ultimately, this leads to products being lost and unreliable information in SAP.

4) Lack of standardized process control: There are no standardized process control loops defined. This means that structural evaluation and regulation of important process parameters is not executed. This means that valuable information is not extracted from the process. For instance, there is control loop built in for vendor rating. When executed, vendor rating could lead to improvements in effectivity.

C. Specific problems for area part of the network

For the area part of the distribution network, a total of seven specific problems have been identified.

1) Incorrect standards for inventory management: Inaccurate information from PAX-forecast. This results in the fact that currently the replenishment is done assuming 100% PAX-density on the flights. Also, there is no accurate knowledge about the consumption per PAX. Because of the lack of accurate information about PAX-forecasts and the consumption per PAX, efficient replenishments for outstations based on actual needs are not possible. Therefore, substantial safety stocks have been installed (3 full weeks) that result in high costs.

2) No exact information about local inventory levels: Because KLM specifies that caterers need to provide information about the inventory levels in their warehouse (and not also about the working stock), the exact inventory levels are not known. This means that when just before the scheduled count of inventory levels a pallet with Coca Cola has been transported to the working stock, it seems that this entire pallet has been consumed in that period of time. This results in sending a new pallet, while actually the pallet is only just transported to the work floor. Without exact knowledge about inventory levels it is much harder to efficiently replenish the inventory at an outstation.

3) Incorrect standards for decision of transport modality: In order to minimize the costs, the preferred transport modality for a shipment is examined. Usually, sending shipments through sea freight is the cheapest option. However, the decision between using sea- or airfreight is not made with complete information. There are a lot of factors that are left out of the equation, meaning that the decision is currently based on cost price only, but no cost factors concerning possible risks with local customs, unstable lead-times, etc. are taken into account. The result is that it is not always clear whether choosing a transport modality is leading to a minimization of costs.

4) Incomplete control loop dispatching area shipments: The area shipments are prepared at KCS Warehouse. A single operator is dedicated to assemble a shipment. However, two problems came up with respect to preparing shipments.

The first problem is that operators do not always register the products they take out of inventory. This leads to discrepancies between SAP and the actual inventory.

The second problem is that there is not a complete feedback loop when the shipment is checked before it is handed over to the logistic service provider. For example, a certain product that is needed in the shipment is not present in the warehouse when the employee is picking the order. But it is possible that this product is delivered somewhat later that day. The logical thing to do is to check whether products that were not present at the beginning of the day, have been delivered later on so that the shipment can be completed after all. This simple feedback loop is not present in the current situation.

5) Lack of standards on desired service levels: The operational planning department needs well-specified standards for them to be able to work according to specifications. These standards include agreements on desired service levels of the inventory at the outstations, on service levels with the logistical service providers and, maybe the most important of them all, clear agreements on the desired service levels on the service that Product Management wishes to serve the passengers. These standards are not defined, or very poorly and in an unclear way.

6) Unclear lead-times of all steps in the network: There is no clear definition of the lead-time of the different process steps needed in the distribution network. This makes the planning of shipments complex, because there is an uncertainty in the required amount of time it takes to have replenishments at the desired locations. This effect is increased by the fact that there exist differences between the lead-times that SAP uses and the actual lead-times (for instance, SAP uses a lead-time of 52 days for the outstation Xiamen in China, while the actual lead-time of Kuehne Nagel is 71 days). This means that the reliability of the inventory at KCS Warehouse is compromised.

7) Shortage of theoretical knowledge about inventory management: The planners work with SAP and in order to understand the system and for instance the order advices it produces, it is important to have a clear understanding of the theory of inventory management. Unfortunately, the planners do not have extensive knowledge on this subject.

IV. Solutions to Identified Problems

This section contains solutions to the identified problems of the previous section. First, two important boundary conditions for a new control model are described. Then the defined performance indicators are defined, followed by the new control model for the catering distribution network.

A. Necessary boundary conditions

Two boundary conditions must be unambiguously defined in order to be able to assess the performance of the distribution network in an objective manner.

1) Clear Normative Outcomes of Portfolio Development: Dealing with varying types of products in a successful manner requires a clear classification of products within the product groups, assigning class specific attributes like for instance strategic importance, safety importance and customer appreciation to them. The result of such a classification is that a service level is assigned to each product (or group of products).

Different categories of products can be treated different with respect to purchasing and inventory management. Kraljic [5] identifies four different product categories with corresponding purchasing strategies that can be very useful in differentiating the product portfolio. These categories are: Strategic Products, Bottleneck Products, Leverage Products and Routine Products.

2) Knowledge about on board consumption: Knowledge about on board consumption is important because of three reasons: it enables KLM to identify destination-specific demands of passengers, it enables KLM to reduce the on board oversupply of catering articles and it enables KLM to improve the effectivity and efficiency of providing the passengers their catering service.

These two boundary conditions must be met in order for the new control model to be effective.

B. Definite formulation of performance indicators

In order to be able to objectively assess and influence the performance of the distribution network, it must be clear which performance indicators should be measured and assessed. These *key performance indicators* (KPI's) have been defined and are shown in Table 3.

Please note that indicators 1a, d, g all are aimed to assess the correctness of deliveries, but concern different sorts of deliveries by different stakeholders. The same goes for 1b, e, h; 1c, f, i; 2a, b and 2f, g, h.

C. High level new control model for distribution network

The entire supply chai is developed in order to satisfy passengers. Therefore, decisions with respect to inventory management and sending replenishment shipments are made from 'right to left', meaning that the important decisions around the distribution are based on passenger demand. Customer behaviour triggers the distribution, meaning a shift from an entirely PUSH-oriented network towards a demand-controlled PUSH distribution network.

The new control model is depicted in Fig. 2, right after the references. However, specific control models for the central- and area supply chain are defined by zooming in on specific parts of the high level control model at this stratum.

TABLE III
DEFINED KPI'S FOR THE CATERING DISTRIBUTION NETWORK

CATEGORY		KPI	UNIT
Reliability of inventories	1a, d, g	Correctness deliveries (quantity)	%
	1b, e, h	On time delivery suppliers	%
	1c, f, i	Discrepancy actual stock levels and SAP values	%
Costs	2a, b	Non-performance costs – Repair Transp. Costs	# and €
	2c	Non-performance costs – Obsolete Products	% and €
	2d	Non-performance costs – Deteriorated Products	% and €
	2e	Non-performance costs- Custom Fines	€
	2f, g, h	Value of Inventory	€
	2i	Extra Warehousing	Hours
	2j	Normal Transportation Costs	€
Quality	3a	Accuracy PAX Forecast	%
	3b	Accuracy Forecast Consumption	%
	3c	Accuracy Lead-time LSP	%
	3d	Quality Supplier Delivery Conform Spec.	%
	3e	Damaged Goods Due to Transportation to OS	%
	3f	Corporate Social Responsibility Factors	Misc.

D. New control model for central supply chain

By zooming in on the specific functions of the high level control model that are concerned with the central inventory management, some more specific control loops can be assigned in order to enable KLM to objectively assess and influence the performance of the central supply chain. These control loops concern the following topics:

- Exchange of Order Information through Automated IT-systems,
- Check on Correctness of Located Products,
- Vendor Management,
- Warehouse Performance Management,
- Improving Quality of Masterdata.

Also, through a combined effort towards optimization of the central supply chain through collaboration with suppliers, cost savings of around 5.8 million euros can possibly be realized by implementing VMI [6] in combination with EDI [7]. The control model is depicted in Fig. 3; placed after the references.

E. New control model for area supply chain

By zooming in on the specific functions of the high level control model that are concerned with the area inventory management, some more specific control loops can be assigned in order to enable KLM to objectively assess and influence the performance of the area supply chain. These control loops concern the following topics:

- Add-the-missing at Final Check of Area Shipments,
- Logistic Service Provider's Performance Management,
- Caterer's Performance Management.

Another way to improve the controllability of the area supply chain is to make the area planner responsible for the performance of the entire chain; from making orders, via dispatching shipments to monitoring of inventory management at the outstation. The model is depicted in Fig. 4.

F. Applicability of new control model

Because the control model is designed from the ground up, it was not possible to benchmark the current situation and thereby it was hard to quantitatively support the so far purely qualitatively formulated control model. However, it is important to somehow prove that the suggested theoretical improvements are actual achievable in practice. To this end, the next section will contain a quantitative case study as a way show the potential results of the proposed control model.

V. Quantitative Case Study

The aim of this section is to add quantitative proof to the newly designed control model for the catering distribution network of KLM. By doing this, the relevance of the new control model becomes clear with the possible savings achievable by implementing it. Using a hypothetical *outstation X* it is possible to show how improvements on the important process criteria lead to substantial cost savings throughout the supply chain.

A number of assumptions were necessary to build the case study, among which were selection of aircraft type, time of day of the flight, included part of the product portfolio, desired service levels, passenger occupation rate and on board consumption. The last two were based on actual data, the first being passenger occupancy figures over the first eight months of 2012, the second is data of consumption on EUR flights as measured in March 2012 by counting over 200 EUR-flights.

The results of this case study look very promising, with significant cost savings. These savings are divided over a few categories, being:

- Value of inventory
- Non-performance transportation costs
- DOW-savings (savings on weight of the flight)
- (Regular Transportation Costs)

The last factor is a possible saving that is only applicable when the used container size drops from 40' to 20'. By extrapolating the average results of outstation X for all 58 outstations, a prediction of the total savings was made. The results of this are shown in Table 4.

TABLE IV
Possible Cost Savings of New Control Model

FACTOR	CURRENT SITUATION [*1000 €]	NEW SITUATION [*1000 €]	SAVING [*1000 €]
Avg. Value of Beverage Inv.	673,05	423,28	249,77
Avg. Non-Perf. Trans. Costs.	1.091,96	349,43	742,53
DOW-savings	-	-	1.360,59
TOTAL SAVINGS (without Reg. Trans. Costs)			**2.352,90**
(Reg. Trans. Costs)	(2.912,95)	(2.186,99)	(725,96)
TOTAL SAVINGS (with Reg. Trans. Costs)			3.078,86

VI. Conclusions and Recommendations

The most important conclusion is that the organizational process of distributing catering articles was well layed out, but the lack of process- and function control caused the identified problems. After implementing these important control loops in the newly designed control model, significant savings of 2,3 million euros can be expected.

Three recommendations should be added to these conclusions. The first is that the collaboration between the different departments involved in the distribution of catering articles should be improved in order to realize improvements through the whole supply chain. The second recommendation is to gather knowledge about customer preferences fast. The third recommendation is to investigate the promising possibilities of VMI and EDI for the central warehouse.

Acknowledgment

The authors would like to thanks all involved departments for their enthusiasm and support in the proceedings of this research. Hopefully it provides KLM with useful insights for restructuring their worldwide catering distribution network.

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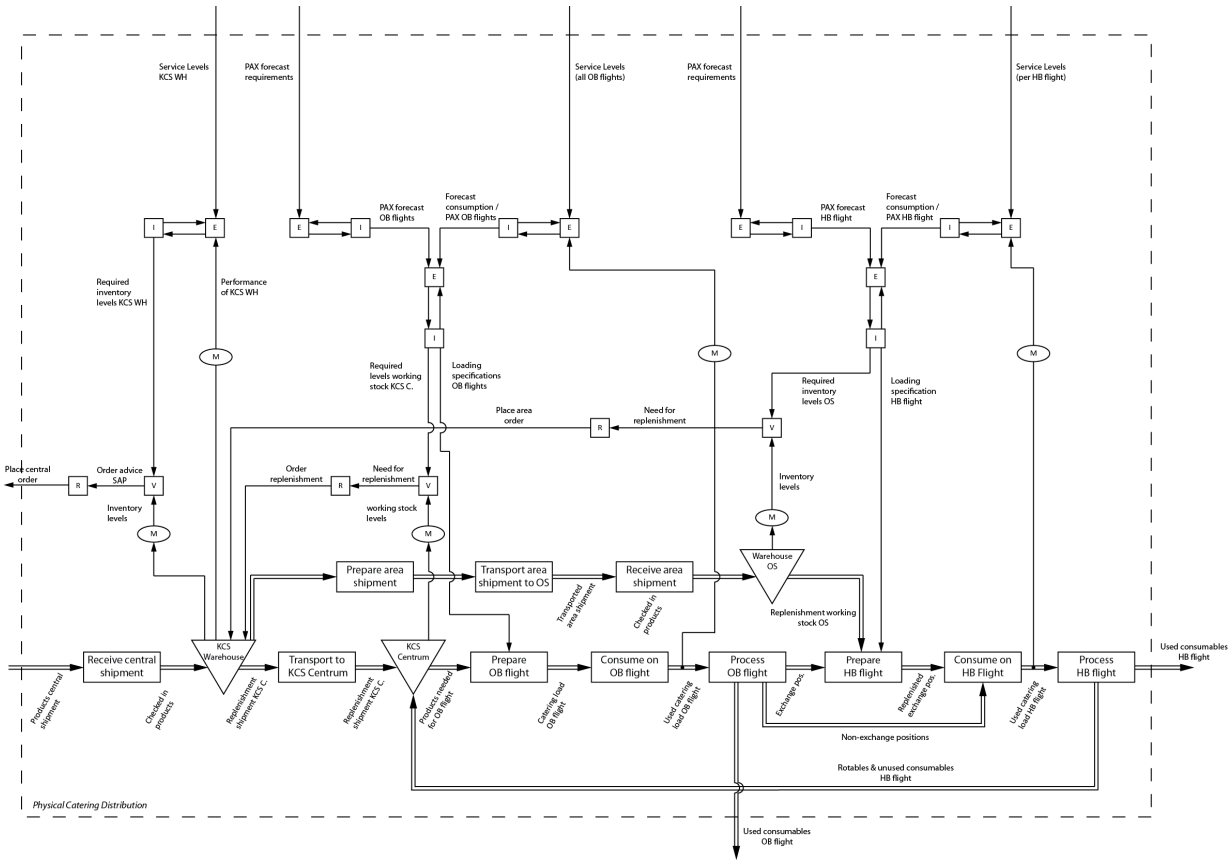

Fig. 2 Redesigned control model for catering distribution network

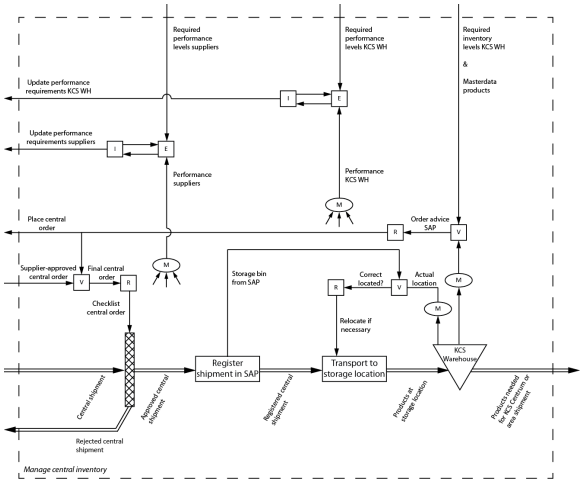

Fig. 3 Redesigned control model for central supply chain

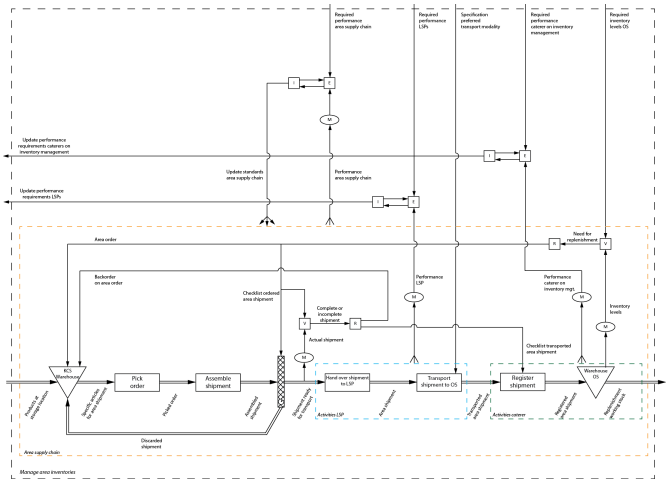

Fig. 4 Redesigned control model for area supply chain

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Appendix B – Basic elements for analysis of KLM Passenger Business

Appendix B1 – Rich picture KLM Passenger Business

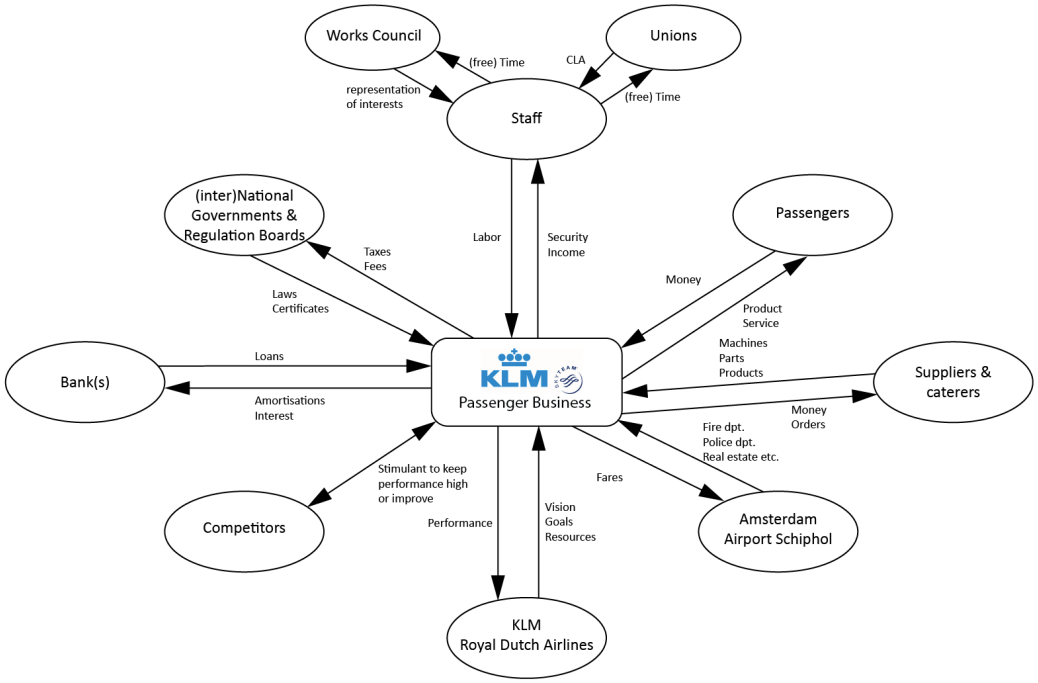

Figure B1 – Rich picture KLM Passenger Business

Appendix B2 – CATWOE-analysis KLM Passenger Business

Client:	Passengers with a need for air transportation
Actor:	KLM's staff (both on the ground and in the air)
Transformation:	Transporting passengers from destination A to destination B in a fast, safe and service oriented way
Worldview:	There is a strong need for fast global transportation due to the globalization of the past century. This transportation is more valued when it comes with a good service in order for passengers to be able to rest and relax.
Owner:	KLM Royal Dutch Airlines
Environment:	KLM Passenger Business is limited by strict (inter)national law and strives to comply to these regulations at all times. Also the safety and working environment for the employees is a constant focus point. The airline industry is a difficult market, therefore KLM is always striving for increasing efficiency in its activities.

Appendix B3 – Root definition KLM Passenger Business

A KLM controlled system, in which the different units (technical, flight, logistics and administrative) share responsibility for using aircrafts for the safe, fast and service oriented transport of passengers from a starting destination A to a final destination B under the restrictions that enough capacity and profitability is achieved in order to prolong the activities into the future.

Appendix C – Total product portfolio of NSM

Art. no.	Article	Art. no.	Article	Art. no.	Article
3001	SAUNF SUPARI AFTERMINT SACHETS	54316	DELAIRE SAUVIGNON BLANC (W)	72747	TRAY-INSERT OUTSTATIONS
3011	COFFEE GROUND TIN=238 GRS	54322	GOTIM BRU 2009 (R)	72748	TRAY INSERT DUTCH LAMMETJE
3080	PILLOWBAG COFFEE	54323	KLEIN CONSTANTIA (R)	72749	TRAY INSERT DUTCH WINDMILL
3211	COFFEE DECAFF.	54324	KAIKEN CABERNET SAUVIGNON DUMM008	72751	TRAYMAT CHEESE / FRUIT
3500	WBC TEA BOX DILMAH	54325	CHATEAU DE PENNAUTIER (R)	72755	LEKBAK GROOT
3501	83452 - TAG BAG FOIL PREMIUM DILMAH	54326	YALUMBA SHIRAZ VIOGNIER (R)	72756	LEKBAK KLEIN
3502	82844 - TAG BAG FOIL EARL GREY DILMAH	54327	MARLBOROUGH ESTATE RES. PN 2011 (R)	72757	INSERT VOOR LEKBAK KLEIN
3503	82888 - TAG BAG FOIL LEMON DILMAH	54328	ZUMBAUM SYRAH GRENACHE (R)	72762	KLM 48.140 STICKER AIRWAY BILLS
3504	83274-TAG BAG FOIL GREEN DILMAH	54329	CASA SILVA DONA DOMINGA 2009 DUMM003	72763	ROLETIKETTEN BLANCO THERMO TOP
3505	82886 - TAG BAG FOIL PEPERMINT DILMAH	54330	MONSOON VALLEY SHIRAZ 2010 DUMM31	72767	365 UNSERVICEABLE SEAL
3506	84910 TAG BAG FOIL ROIBOS NATURAL DILMAH	54331	EMILIANA ELEMENTAL CARMENERE DUMM003	72781	A LA CARTE STICKER SILVER
3507	82944 - TAG BAG PREMIUM Mcl. DILMAH	54332	MONTE VIBIANO CUVEE MARIA CAMILLA (W)	72785	A LA CARTE WAXED PAPER *PAML*
3509	GREEN TEA JASMINE RDS - China -BKK-TPE	54333	STRANDVELD FIRST SIGHTING SHIRAZ DUMM031	72786	A LA CARTE BOX
3512	JAPANS TEA YAMA RDS - Japan	54452	CAMPARI MINI	72787	A LA CARTE WAXED PAPER PBML
3513	BLOND THEE - OS 2012	54581	HEINEKEN BEER 25CL	72788	A LA CARTE WAXED PAPER PVML
3625	JAPANSE CUP NOODLES NEW 2008	59992	SAKE HAKUSHIKA GINJO NAMACHOZO 0,5L	72789	A LA CARTE WAXED PAPER EPCML
4043	KOSHER HOT MEAL BEEF	61611	CHAMPAGNE CORK (1CN=100pcs)	72791	A LA CARTE WAXED PAPER DUTCH MEAL
4044	KOSHER HOT MEAL VEGETARIAN	61620	WIJNKURK VOOR HERKURKEN	72850	HEAT RES. STICKER CH. MCL. 2006
4046	KOSHER MEAL COLD BREAKFAST	61671	PLASTIC DISPOSABLE PINCERS	73000	CARTON RETOUR WIJN
8207	Newsweek (52 times/year)	61720	GREY PLASTIC ROLL BASKET	73001	INSERT CARTON RETOUR WIJN
8211	Carros (8 times/year)	61730	TRAY BASKET	73002	SNACK BOX (Tidbits)
8212	Nautique (8 times/year)	62001	MW KNIFE STAINLESS STEEL MAR11 EUR/ICA	73004	INSERT TBV SNACK BOX (73002)
8216	Objekt (4 times/year)	62011	MW FORK STAINLESS STEEL MAR11 EUR/ICA	73021	CREWBOX - EX BS
8218	Columbus (6 times/year)	62021	MW SPOON STAINLESS ST MAR11 EUR/ICA	73041	CHILDBOX JUNGLE
8220	Golf World (12 times/year)	62022	MW SPOON DISPOSABLE EUR	73042	CHILDBOX UNDER WATER WORLD
8222	Architectural Digest (9 times/year)	62031	MW COFFEE SPOON STAINLESS MAR11 EUR/ICA	73092	CREWBOX - EX AMS
8225	Tableau (6 times/year)	62032	MW COFFEE SPOON DISPOSABLE EUR	73130	PANTRY OUTFIT BOX
8226	National Geographic (12 times/year)	62041	MW CAKE SERVER STAINLESS MAR11 ICA	73170	WASTEBOX - ICA + EUR
8228	Elegance (12 times/year)	62042	MW DISP CUTLERY SET EUR	73300	MINIATURE BOX
8231	The Economist (52 times/year)	62501	MW CHINA PLATE MEDIUM MAR11 ICA	73311	COCKPITBOX - EUR
8233	DER SPIEGEL (52 times/year)	62502	MW CHINA CASSEROLE ROUND MAR11 ICA	73321	INSERT MINIATURE
8236	HP DE TIJD (12 times/year)	62503	MW CHINA CASS MOON MAR11 EUR/ICA	73340	TOILETKIT BOX
8237	COSMOPOLITAN (12 times/year)	62504	MW SIDE PLATE MAR11 EUR/ICA	73350	CONDIMENT INSERT BOX
8880	SUGAR TUBES KLM	62505	MW COFFEE MUG MAR11 EUR/ICA	73351	MW BOX FOR TRAY ITEMS BLUE MAR11 EUR/ICA
11818	WILHELMINA PEPERMUNT	62506	MW SIDE PLATE ROUND	73352	MW BOX TRAY ITEMS

	WBC		EUR/ICA		RED MAR11 EUR/ICA
11910	SWEETENER TUBE KLM	62511	MW CHINA PLATE SMALL EUR	73354	MW BOX FOR TRAY ITEMS ORANGE EUR
19673	SMOKED ALMONDS 12 Gram	62512	Cup & saucer Blond Amsterdam - Cup *NEW*	73355	MW DUTCH BOX FOR TRAYITEMS R/W/B
19674	TASTE OF NATURE CRANBERRY BAR	62513	Cup&saucer Blond Amsterdam - saucer *NW*	74005	CUTLERY PACK CHILD 4/1
19675	WBC MIXED NUTS 450GR	63400	ORIENTAL TEA POT	74012	CUTLERY PACK 2/1 BRF MEDIUM
19679	TASTE OF NATURE PERSIAN POMEGRANATE GARD	63401	ORIENTAL TEA CUP	74020	WOODEN CHOPSTICKS
20962	MENAGESET 3/1	63759	HEINEKEN BIERGLAZEN * LOUNGE*	74040	BOX SERVICE MEDIUM 2008
24851	PEPPER & SALTSACHET KLM	63800	MW WATER GLASS MAR11 ICA	74100	TOOTHPICK JORDAN
26002	SAINT AMAND 1,5LTR WATER	63801	MW WINE GLASS MAR11 ICA	74112	DISP. COCKTAIL STIRRER
26003	SAINT AMAND WATER 0,5LTR	63802	MW LIQUOR GLASS MAR11 ICA	74114	MW SQUASHER ICA
26008	SPA WATER 0,5L CREW	63805	MW WATER GLASS 11CM EUR	75058	WHITE ECONOMY HRCS - AIR LAID
26040	ALPS WATER CUP 125CC	63826	GLASS EUR SELECT ALTERNATIEF	75059	ORANGE ECONOMY COMFORT - HRC AIR LAID
27000	COCA COLA 33CL	63827	MW TESTGLAS EBC	75066	WNF WHITE ECONOMY HRCS JUN-JUL 2012 NEW
27230	FANTA 33CL	64356	2/3 TRAY ICA MCL 2008	75067	WNF ORANGE ECONOMY COMFORT HRC 2012 NEW
27240	SPRITE 33CL	64500	MW Tray 1/1 KSSU MAR11 EUR/ICA	75086	DISPOSABLE PILLOWSLIP M-CLASS
27241	SPRITE ZERO 33CL	64505	1/1 TRAY BLACK	78060	CHILD BIB NIJNTJE
27242	SCHWEPPES GINGER ALE 33CL	64507	MW TRAY 2/3 KSSU EUR	79032	FACIAL TISSUES PACK
27243	SCHWEPPES SODA WATER 33CL	64523	1/2 TRAY BLACK	79034	PAPER KITCHENROLL PK = 2 ROL
27244	SCHWEPPES TONIC 33CL	65000	OCR Fitted sheet	79040	PAPER TOILETROLL NEW 2007
27248	FERNANDEZ GREEN PUNCH -12TN	65003	OCR Pillowslip	79041	PAPER HANDTOWEL LONG
27250	NESTEA 33CL	65004	FCR Fitted sheet	79042	PAPER HANDTOWEL KLC
27260	ORANGE JUICECUP CALYPSO 85ML	65006	OCR KLM crew jogging broek	79043	PAPER TOILETROLL KLC
27303	ORANGE NECTAR KRINGS 1.0LTR	65007	OCR KLM crew jogging trui	79210	WBC HOTTOWELS
27312	APPLE NECTAR KRINGS 1.0LTR	65008	OCR Blanket	79215	EBC Hottowel
27332	TOMATO JUICE KRINGS 1.0LTR	65009	OCR Pillow	79301	HOT TOWEL RITUALS M-CL *ALT. JULI 2011*
27341	MERANO ORANGE JUICE 15CL	65012	WBC HRC	79303	M-CL HOT TOWELS 2010
27342	MERANO APPLE JUICE 15CL	65016	WBC DUCK FEATHER PILLOW NEW	80022	EYEMASK 2011
27451	PERRIER SPR. MIN.WATER. 33CL	65017	WBC PILLOW SLEEVE NEW	80051	EARPLUGS 2011
27470	COCA COLA LIGHT 33CL	65053	BLANKET WBC 2010	80075	SLIPPERS LARGE 2011
27471	Coca Cola " ZERO " 33cl	65061	ROTABLE BLANKET BAG	80076	SLIPPERS MEDIUM 2011
27751	SPA WATER 1,5LTR CREW	65072	BLANKET M-class 2008	80212	MOPS WHITE 2008
27860	COCA COLA 15CL	65075	ISO BLANKET	80240	AEROFRESHENER
27880	COCA COLA LIGHT 15CL	65079	Oranje Dekens voor IFS	80251	INSECTICIDE SPRAY 2011
36911	STICKERVEL SP-MEALS WIT 38x21,2mm	65110	MW NAPKIN WBC MAR11 ICA	80266	CLEANING WIPES
39901	Enq. Pouche KLM/KLC-flight RED (EB)	65111	MW TABLE CLOTH WBC MAR11 ICA	80270	FLIGHT FRESH BLOC LEMON GRASS 5500 Y
39903	Enq. Pouche ICA 400/500 SKY BLUE (I3)	65290	WASHABLE M CLASS PILLOW	80403	WBC AMENITYKIT GRAY 2011 FOR MEN
39904	Enq. Pouche ICA 600 GR (I1)	66122	KLEDINGHANGER (120 PCS / CN)	80404	WBC AMENITYKIT GRAY 2011 FOR LADIES
39905	Enq. Pouche ICA 700 NAVY BLUE (I2)	66210	STOFFER + BLIK	80409	WBC AMENITYKIT 2012 FOR MEN BLACK *NEW*
39906	Enq. Pouche ICA 800 ORANGE (I4)	66683	DISPOSABLE HEADSET MCL	80410	WBC AMENITYKIT 2012 FOR LADIES PINK *NW*

39907	Enq. Pouche ICA Korea PINK (I5)	66700	HEADSET NOISE CANCELLATION (WBC)	81051	TOILETSEAT COVER 2012 NEW
39908	SCORE Distribution list KLM/KLC	66701	HEADSET NOISE CANCELLATION WBC 888NC	81102	SANITARY NAPKIN 2012
39960	BLACK CUSTOMSSEALS SPLHH ONLY CN=2000	66720	LEATHERETTE EARPADS FOR HEADSET NOISE C.	81113	BABY DUMMY 2008
39970	ORANGE CUSTOMSSEALS	66721	LEATHERETTE EARPADS HEADSET WBC 888NC	81124	BABY DIAPERS
39975	BLUE CONTAINER SEALS CN=2000	66722	BLACK INNER SPONGE WBC HEADSET 888NC	81170	SOAP BOTTLE EM190 KLC
39976	KCS GREEN FLEXISEALS CN=2000	67050	LEATHER HRC EUROPE	81180	SOAP DISPENCER "REFLECTION"
40270	INSTANT MISO SOUP RDS JAPAN	67051	LEATHER HRC EMB190	81301	DEODORANT RITUALS SILVER "COOL"
51161	CHIVAS REGAL 12 YRS OLD 0,7L	67052	LEATHER HRC FOKKER 70/100	81302	FACE LOTION RITUALS SILVER "FACE #3"
51183	DEWARS WHITE LABEL 0,05 ltr	67053	LEATHER HRC EUROPE F/Y COMFORT	81303	FACIAL CLEANSER RITUALS SILVER AWARENESS
51190	JIM BEAM KENTUCKY BOURBON 0,5L	67054	LEATHER HRC FOKKER 70 F/Y COMFORT	81304	HAND&BODY LOTION RITUALS SILVER INFINITY
51220	*WHISKY DEWARS 0,5L ICA Mcl*	69000	RDS JAPAN Square bowl	81356	DISP. PLASTIC LID FOR 71357
51904	GLENLIVET MALT 5CL	69001	RDS JAPAN Umbrella bowl	81389	LID FOR 71346 = DISP.SD ICA M-CL '06 RDS
51907	HIGHLAND PARK VINTAGE 1998 - 1 ltr	69002	RDS JAPAN Pickle Plate	82001	WARAN / EUROSKY MAGAZINE
52005	CAMUS COGNAC 0,03 ltr	69003	RDS JAPAN White Bowl	82015	HOLLAND HERALD "ONEVEN MAANDEN"
52006	CAMUS COGNAC 1 ltr	69004	RDS JAPAN Large Miso Soup Bowl	82016	HOLLAND HERALD "EVEN MAANDEN"
52040	REMY MARTIN VSOP 0,7LTR	69005	RDS JAPAN Lid for LG Miso Soup	82021	HOLLAND HERALD REGIO "ONEVEN MAANDEN"
52600	ABSOLUT VODKA 0,5 L	69006	RDS MAINDISH / Casserole	82022	HOLLAND HERALD REGIO "EVEN MAANDEN"
52620	BOLS JONGE JENEVER MINI	69010	RDS LID CASSEROLE FOR 69006	82025	EUROSKY CHINA MAGAZINE
52665	GORDON'S GIN 0,05 ltr	69011	RDS JAPAN CHOPSTICK HOLDER	82065	INFLIGHT SERVICE MAP
52680	BOMBAY SAPPHIRE GIN 0,7L C.CL.	69012	RDS POPOUT CASS FOR 69006	82066	INFLIGHT SERVICE MAP SPL/NN
52871	BACARDI WHITE RUM 0.5L 24BT per CARTON	69013	RDS JAPAN UNDERPLATE NEW	82363	FB CARD CN=4380
52881	BACARDI WHITE RUM MINI	71023	DISPOSABLE GLASS AF-KLM	82420	KLM CLOSING SEAL TRANSPARANT
52902	ABSOLUT BLUE VODKA 5CL GLASS	71030	DISPOSABLE CUTLERY SET M-CL	83535	WNF FUNCARD
53451	DRAMBUIE 0.5L	71102	CUP WHITE	83541	CHILDKIT INBOUND
53453	AMARULA 0.5L	71105	DISPOSABLE LID FOR CUP WHITE 71102	83542	CHILDKIT OUTBOUND
53459	BAILEYS MINI	71113	DISP.NATURE CUP DUTCH DESIGN	84005	SEALFOIL ROBERTPACK MACHINE PALLETWIKKEL
53460	COINTREAU MINI	71117	DISP.NATURE CUP BLOND JUL/AUG	84006	LDPE FOLIENEUTRAAL RL=25KG TBV PALLETDEK
53465	COINTREAU 0,5L	71120	LILY CUP FLAT BOTTOM 3oz CUP	84011	PLASTICBAG ICEDRAWER
53470	DRAMBUIE MINI	71322	MW ROTABLE FRUIT BOWL MAR11 ICA	84016	DBH PLASTIC SECURITY BAG
53509	Croft Pink Port 0,5 lt - DUM039	71323	MW ROTABLE COFFEE TRAY	84035	BOARD SUPPLY BAG
53511	Taylor LBV Port 0,5L - dumm33	71324	MW ROTABLE UNDERPLATE ROUND MAR11 ICA	84040	PLASTIC BAG DEFECT HEADSET - RED
53586	Champagne Billecart Salmon Brut - dum030	71325	MW ROTABLE NUTS BOWL MAR11 EUR/ICA	84055	WASTEBAG GREEN
53591	CODORNIU BRUT CN=24X20CL-dum037	71330	MW FRUIT FORK MAR11 ICA	84059	DELTA WASTEBAG 580 x 1000 mm, 30 mic NEW
53649	GRAN FUEDO EDICION - dum038	71331	DESSERTSPOON	84062	WASTEBAG BLUE PLASTIC
53654	GRAN FUEDO EDICION PET- dum038 NEW	71332	MW DISPOSABLE SALAD BOWL MAR11 EUR/ICA	84070	WASTEBAG RED
53746	Cono Sur Organic Chardonnay-dum040	71333	MW DISPOSABLE SIDE BOWL EUR	84075	PLASTICBAG EUROPA
53750	CONOSUR ORGANIC CAB. SAUV/CARMENERE D041	71334	MW TEA HOLDER MAR11 ICA	84108	KLM GENERAL TRANSPARANT BAG
53760	NATURALYS SAUVIGNON BLANC DUMM42	71335	MW DISP. CUP CLEAR	84111	AIRSICKNES BAGS

53761	NATURALYS CHARDONNAY DUMM42	71336	MW DISP. CUP BLACK	84160	PLASTIC GLOVES
53769	MCL LA BAUME RESERVE RED WINE DUMM035	71337	MW DISPOSABLE MAIN PLATE MED WHITE EUR	84172	OVENGLOVES MEDIUM
53969	THE NED SAUVIGNON BLANC (W)	71338	MW DISPOSABLE MAIN PLATE LARGE EUR	84173	OVENGLOVES LARGE
53972	Lillypilly Estates Sweet Harvest (D)	71346	DISP. SD ICA M-CL 2006 RDS (TRANS)	84200	BLANKETBAG YELLOW
53975	PRUNOTTO MOSCATO D'ASTI (Dessert)	71357	DISP. SIDE DISH ICA M-CL 2008	84201	LARGE BAG TRANSPARANT (*STRONG*)
53976	PRUNOTTO MOSCATO D'ASTI 0,75 LT DESSERT	71425	MW SALT&PEPPER SHAKER MAR11 EUR/ICA	84294	DRINKING STRAW
53979	MCL TERRA ANDINA RED WINE	71435	SALT & PEPPER SHAKER DUTCH BLUE *NEW*	84351	MW COVER CHINA PLATE SMALL EUR
53980	MCL TERRA ANDINA WHITE WINE	71618	DISP. C-PET CASS ICA M-CL 2006	84352	MW COVER SIDE PLATE ROUND EUR
54061	Kleine Schorre SD Rivaner (W)	72005	SANDW HOT BAG VEGETARIAN PL DESIGN	84361	MW POP OUT CASSEROLE MOON 62503 MAR11
54070	Gerard Bertrand Crémant limoux - dum067	72006	SANDW HOT BAG PL DESIGN	84362	MW POP OUT CASSEROLE ROUND 62502 MAR11
54226	Lady Librije SAUV. BLANC (W)	72042	MW DISPOSABLE NAPKIN DESSERT	84370	MW COVER CASSEROLE ROUND 62502 ICA
54227	CIMBRON VERDEJO (W)	72071	COCKTAILNAPKIN 2010	84371	MW COVER CASSEROLE MOON MAR11 EUR/ICA
54228	CASA SILVA COAST SAUVIGNON BLANC (W)	72075	COCKTAILNAPKIN 2012-2014 *new*	84386	MW COVER PLATE MEDIUM 62501 MAR11 ICA
54230	GUADO AL TASSO VERMENTINO DUMM032	72076	NAPKIN DUTCH FESTIVAL 2012 *new*	84387	MW COVER SIDE PLATE 62504 MAR11 EUR/ICA
54231	TORMARESCA CHARDONNAY (W)	72301	TR.SERVIETTES WHITE 38X27 *2008*	84388	MW COVER FRUIT BOWL 71322 MAR11 ICA
54232	CAMPOGRANDE ORVIETO (W)	72342	MW TRAYLINER BLACK MAR11 ICA	84389	MW COVER SALAD BOWL 71332 MAR11 EUR/ICA
54233	BENITO SANTOS TERRA DE CALAGO '10 (W)	72343	MW TRAYLINER WHITE MAR11 ICA	84390	MW COVER NUT BOWL EUR
54235	CIGALUS BLANC 2009 (W)	72344	MW TRAYLINER BLUE MAR11 ICA	84393	MW COVER DISP AMUSE CUP
54236	CHATEAU CANET MINERVOIS (R)	72346	MW 1/1 TRAYLINER ORANGE 2012 *NEW*	84394	MW COVER DISP SIDE BOWL EUR
54237	CASA SILVA RESERVA VIOGNIER 2010 (W)	72350	MW TRAYLINER 2/3 BLACK EUR	84395	MW COVER DISP MAIN PLATE LARGE EUR
54238	LOUIS JADOT MÂCON GRANGE MAGNIEN (W)	72357	MW TRAYLINER 2/3 ORANGE 2012 *NEW*	84396	MW COVER DISP MAIN PLATE MED EUR NEW
54239	DOMINIQUE CORNIN MACON CHAINTRE DUMM007	72421	MW NAPKIN HOLDER BLUE MAR11 ICA	89998	PLASTIC PALLETS FAR EAST " BLOK "
54240	STUMP JUMP STICKY CHARD.2010 DUMM034	72422	MW NAPKIN HOLDER RED MAR11 EUR/ICA	89999	PLASTIC PALLETS FAR EAST " EURO "
54241	JORDAN SAUVIGNON BLANC 2011 DUMM32	72426	MW DUTCH NAPKINHOLDER ORANJE	U62001	MW KNIFE STAIN STEEL UNPACKED EUR/ICA
54242	STUMP JUMP LIGHTLY WOODED CHARD'11 DUM4	72591	BIG BOX 2008	U62011	MW FORK STAIN STEEL UNPACKED EUR/ICA
54243	CASTEL FIRMIAN PINOT GRIGIO DUMM007	72705	1/2 TRAYMAT	U62021	MW SPOON STAIN STEEL UNPACKED EUR/ICA
54244	JEAN-PIERRE BAILLY POUILLY-FUME (W)	72707	TRAYMAT 2/3 TRAY	U62031	MW COFFEE SPOON STAIN STEEL UNPACKED ICA
54245	VILLEBOIS SAUVIGNON BLANC PRESTIGE DUM32	72709	1/1 TRAYMAT	U62501	MW CHINA PLATE MEDIUM UNPACKED ICA
54246	HEAVEN ON EARTH DUMM034	72740	TRAY-INSERT RDS	U62502	MW CHINA CASSEROLE ROUND UNPACKED ICA
54247	LEGARIS VERDEJO 2011 DUMM004	72742	TRAY-INSERT BRKF	U62503	MW CHINA CASSEROLE MOON UNPACKED EUR/ICA
54303	TERRA ANDINA CARMENERE-CARIGNAN (R)	72743	TRAY-INSERT WORLD	U62504	MW SIDE PLATE UNPACKED EUR/ICA
54312	DOMAIN GAYDA VIOGNIER 2010 (W)	72744	TRAY-INSERT EUROPE	U62506	SIDE PLATE ROUND EUR UNPACKED EUR
		72745	CN LID C-PET CASS PL DESIGN for 71618	U62511	MW CHINA PLATE SMALL EUR UNPACKED EUR

Appendix D – List of suppliers of NSM

Ranking	Supplier no.	Supplier	# articles
1	4411	HELIOS MPPD B.V.	71
2	92202	De Ster N.V.	57
3	500874	Global C - Nederland B.V.	19
4	501160	Moonen Packaging B.V.	15
5	86010	Coca-Cola Enterprises	13
6	743435	Oerlemans Plastics B.V.	12
7	501998	MADAL BAL BV	10
8	502251	P.I Heerhugowaard	10
9	500984	Noritake Co. Limited	9
10	12870	Groupe LFE Wines Worldwide B.V.	8
11	39180	DGS Wijnkopers B.V.	7
12	93390	Lenoirschuring Drukkers	7
13	501127	Handelsbureau Exclusiva B.V.	7
14	38795	Activin B.V.	6
15	501347	LAMPE Textiles	6
16	20207	Kwast Wijnkopers B.V.	5
17	39598	Oy Fiblon AB	5
18	67628	B&S PAUL GLOBAL INTERNATIONAL	5
19	81213	Bacardi Nederland	5
20	82742	Refresco Benelux	5
21	501248	Long Prosper Enterprise Co. Ltd.	5
22	502196	Textrade International Ltd.	5
23	672221	Van Gelderen Import BV	5
24	96789	Wecovi B.V.	4
25	500192	Etiket B.V.	4
26	500269	Pernod Ricard Travel Retail Europe	4
27	501182	AMS/MN	4
28	502053	ABRIC	4
29	755920	Pelican Magazines/Hearst	4
30	25319	Orvec International Ltd	3
31	27247	Jean Arnaud Wijncommissie B.V.	3
32	96250	Koffiebranderij en Theehandel	3
33	501017	Terra Andina / Sur Andino S.A.	3
34	501623	Maxxium Travel Retail Ltd.	3
35	502064	Langerhuize	3
36	26772	Plastic Modern B.V.	2
37	32648	Celeste Industries Ltd	2
38	35035	Spadel Nederland B.V.	2
39	39862	Codorniu S.A.	2
40	47542	Veriplast International Benelux BV	2
41	48741	Diageo Scotland Ltd	2
42	73590	Heineken Brouwerijen B.V.	2
43	76527	Wijnkoperij Okhuysen B.V.	2
44	89298	Imko Nut Products B.V.	2
45	500357	Horizon Wines	2
46	500390	Beelen B.V.	2
47	500621	Meiland Pallets B.V.	2
48	500643	Nilesk International Limited	2
49	501006	Camus Cognac	2
50	501314	F. van der Vooren B.V.	2
51	502262	Europro S.A.	2
52	502306	St Amand	2
53	3091	Horsleys Ltd	1
54	12562	KLM Catering Inflight Services BV	1

55	14355	Residence Wijnimport B.V.	1
56	25033	Amorim Benelux B.V.	1
57	25121	Great Grapes Wine B.V.	1
58	26012	KLM Catering Services B.V.	1
59	26078	Poot Agenturen B.V.	1
60	26277	#N/A	1
61	26618	#N/A	1
62	35761	McGean Rohco (U.K.) Ltd.	1
63	38588	Intervine Incorporated	1
64	38971	Walraven & Sax	1
65	39488	Vinites B.V.	1
66	39741	Plus Pack A/S	1
67	40107	Transposafe Systems Holland B.V.	1
68	53801	PKS Group	1
69	74844	Bunzl Disposables B.V.	1
70	79563	Royal Leerdam B.V. Glasfabriek	1
71	81411	Marfo (Martinair Food B.V.)	1
72	95579	Verbunt Wijnkopers BV	1
73	500170	Rituals Nederland B.V.	1
74	500302	Calypso Soft Drinks Ltd	1
75	500467	ELAG	1
76	500533	ITW Envopak	1
77	500544	Nipius Latin Wines	1
78	500742	SPH Gérard Bertrand	1
79	500841	Expert Impex	1
80	501039	Overseas Trading Development (OTD)	1
81	501072	Wijnhoeve De Kleine Schorre	1
82	501083	Delta Airlines	1
83	501138	De Ster N.V.	1
84	501171	ams/mc	1
85	501325	German Airline Press	1
86	501336	Champagne Billecart Salmon	1
87	501358	PSA	1
88	501634	Domaine Gayda	1
89	501766	Bossenbroek B.V.	1
90	502086	HANDELSONDERNEMING HUIZINGA	1
91	502097	OVERSEAS TRADING COMPANY NV.	1
92	502152	Yama Products B.V.	1
93	502229	GEDE VERPAKKINGEN	1
94	502295	Oberoi flight services	1
95	502317	floris	1
96	502318	Nestle waters	1
97	502340	SL lederwaren	1
98	502362	Castell del Remei	1
99	502406	MADAL BAL PPST	1
100	502428	CASTELLO MONTE VIBIANO VECCHIO SRL	1
101	502439	AXXENT TEA & COFFEE BV	1
102	502450	LES GRANDS CHAIS DE FRANCE	1
103	732743	The Economist Newspaper Ltd	1
104	735526	Newsweek	1
105	737319	Reismagazine Columbus	1
106	763301	Hans Fonk Publications BV	1

Appendix E – Important stakeholders catering distribution network

Many parties are involved in the total catering distribution network. In this appendix the important stakeholders, both internal as well as external, are mentioned and explained.

INTERNAL STAKEHOLDERS

Cabin Inflight Management

CIM is responsible for the entire product portfolio that is present during a flight. This portfolio must be developed according to the requirements imposed by the marketing department with the goal of delivering the ultimate KLM-experience to the passengers.

The catering articles used onboard are being thought up, developed, bought, stored, controlled, distributed and transferred to the caterers; all this is done by different departments within CIM. Also the steps to be taken when a products reaches its end-of-life status falls under responsibility of CIM.

CIM is divided into four functional departments: (1) Product Management, (2) Network Supply Management, (3) Inflight Retail & Media and (4) Crew Products & Operations. A schematic overview of the organizational structure of Inflight Services is shown in the figure below.

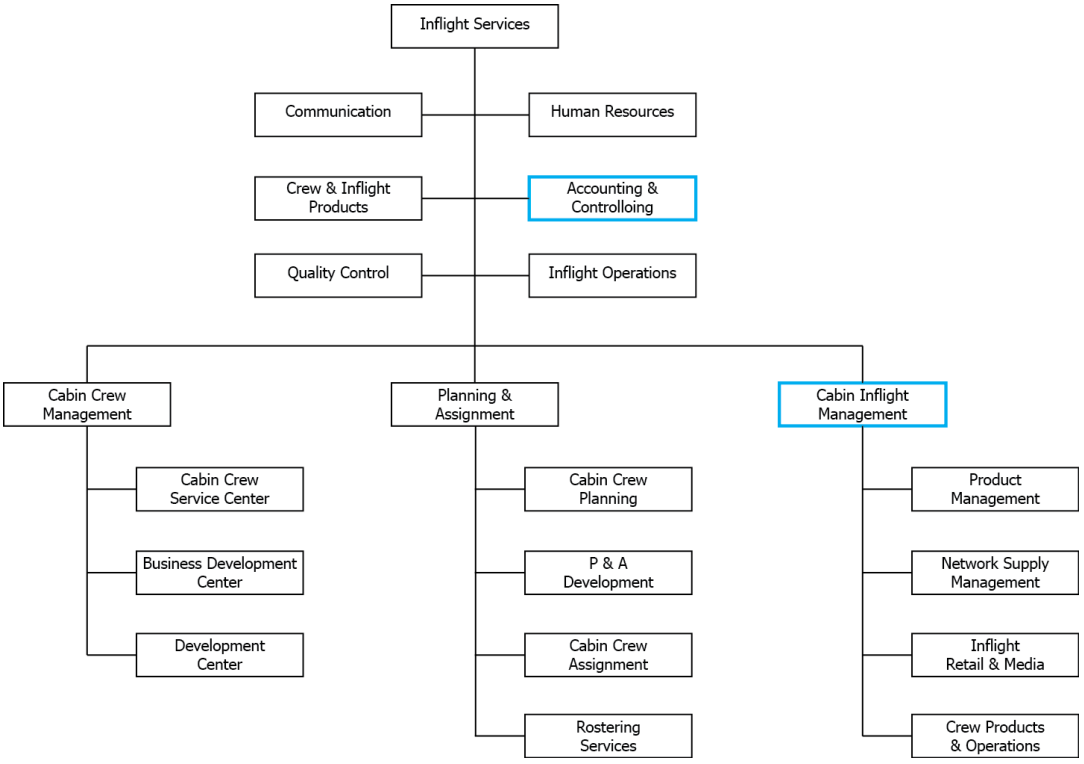

Figure E1 – KLM Inflight Services

CIM – Product Management

This department is responsible for the development of the products to be used onboard. Also the monitoring of the success of a product and the possible decisions based on the performance is the responsibility of PM. KLM has defined three different product groups: (1) World Business Class (WBC), (2) ICA economy class (ICA-M) and (3) Europe. Every product group has a dedicated product manager, who is assisted by a product specialist. The figure below shows a schematic overview of the department PM.

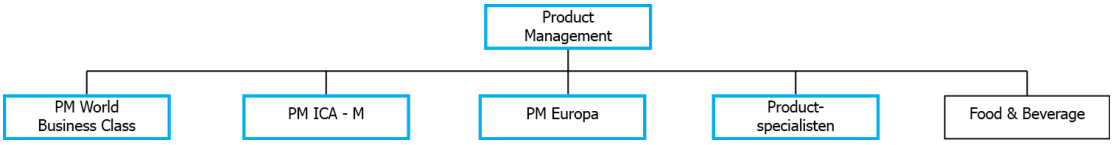

Figure E2 – Product Management

Because of the involvement in the development of the product portfolio and the strong influence of this on the distribution network, PM is an important stakeholder.

CIM – Network Supply Management

This department is responsible for the physical availability of the product portfolio at the required locations. When the specifications of a new product have been determined and accepted, a supplier is selected and the process of physical distribution starts. With physical availability is meant that the catering articles that are needed on a specific flight are available for loading at the location where these actions are carried out. The department is divided into two sub-departments: (1) Regie and (2) Operatie. Both Regie and Operatie are again divided into three separate function groups. This is depicted in the figure below.

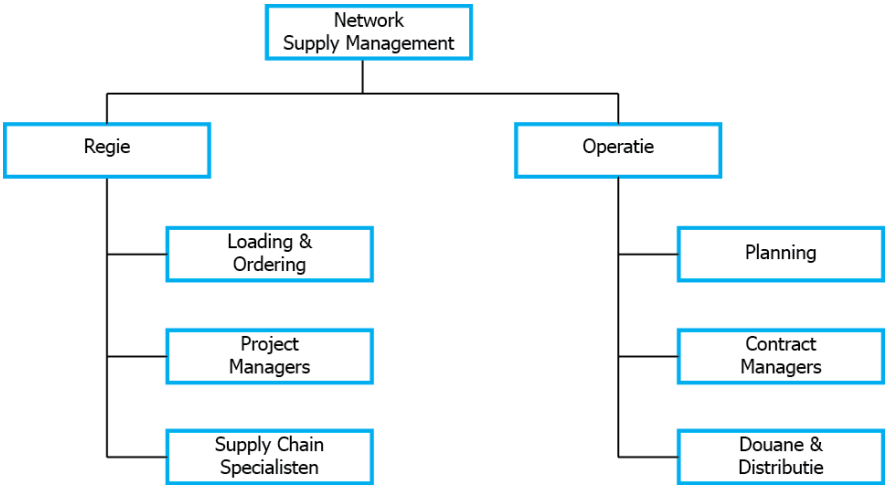

Figure E3 – Network Supply Management

CIM – NSM – Regie

The team of Regie is responsible for the translation of the developments made by PM into workable logistic specifications. Next to that, the team is also responsible for continuous improvements of the supply chain.

CIM – NSM – Regie – Loading & Ordering

Based on the input that PM delivers in the form of service schedules, the department of Loading & Ordering develops a loading plan for the flight. The loading plan is a specification of which article will be placed in which location and in which quantities. The loading plan must comply to requirements with respect to for instance flight safety, galley-layouts and working methodology of the crew.

CIM – NSM – Regie – Supply Chain Specialists

The supply chain specialists are responsible for optimizing the distribution network. To this end they are continuously looking for possible improvements to reduce waste. They are also responsible for creating and monitoring forecasts concerning the usage of articles.

CIM – NSM – Regie – Project Managers

The project managers are responsible for setting up, managing and implementing large-scale projects that influence multiple parts of the supply chain. These projects are focused on implementing improvements to products or processes.

CIM – NSM – Operatie

The team of NSM Operatie is responsible for the daily operations concerning the physical distribution of catering articles. Again, three sub-departments have been defined.

CIM – NSM – Operatie – Planning

The planning department is responsible for the availability of inventory at the outstations and the central warehouse in order to enable the caterers to load the flights with the right catering load. The department is concerned with both the central inventory at Schiphol Noord, as well as the area inventories at the outstations.

CIM – NSM – Operatie – Contract Management

The department CM is responsible for maintaining the contracts with caterers and suppliers. The department concerns itself with the monitoring of the implementation of a contract, monitoring the costs that are being made within the contract, identifying deviations and making sure that the availability of the needed articles is not put in danger.

CIM – NSM – Operatie – Douane & Distributie

This department is concerned with the legal affairs that come up when distributing goods all over the world. The department is also responsible for the contact and dispatch of the logistic service providers.

Accounting & Controlling Inflight Services

This department is responsible for the financial processing of all activities of Inflight Services, including those of CIM. Among the responsibilities are checking and paying invoices to IFS, but also producing passenger-related forecasts. These forecasts can be used in the inventory management of outstations.

All stakeholders described above are part of the KLM business unit Inflight Services. The internal stakeholders described below are not.

KLM Catering Services

KLM Catering Services (KCS) is a 100% subsidiary of KLM and is responsible for all operational catering activities of KLM around Schiphol. KCS has two locations at Schiphol: (1) KCS Centrum and (2) KCS Warehouse. At KCS Centrum the loading equipment is loaded with the required catering articles. KCS Warehouse is responsible for the operational inventory management of the central warehouse.

Procurement

The department Procurement Inflight Services is responsible for all purchasing and tendering activities concerning products that are used onboard and also for the purchasing of accommodation for cabin- and cockpit crews. This department is not part of the business unit Inflight Services, because KLM has chosen to have a corporate procurement organization. The department has five sub departments based on the type of products to be purchased: (1) Accommodation, (2) Transport, (3) Catering, (4) Inflight Hardware and (5) Groceries and Beverages.

Marketing

KLM also has a separate division that is completely focused on marketing. This division is responsible for promoting KLM in every possible way. Marketing is related to Product Management in the way that marketing develops specifications which must held up by the product portfolio that PM designs.

Cabin crew

The cabin crew is a very powerful stakeholder. They form the first line of contact with the passengers onboard. Because of their intensive contact with the passengers, the cabin crew is involved in the development of the products. Their involvement is in the form of a grading committee, from which permission is needed to introduce or change products in the portfolio or anything concerned with the working methodology.

Flight Operations

The entire weight of the catering load obviously has influence on the total weight of the aircraft. The heavier the plane, the more fuel is needed leading to higher operational costs. The department of flight operations is concerned with calculating the DOW and additional factors that are used in determining the fuel need and assessing flight safety issues.

EXTERNAL STAKEHOLDERS

Suppliers

The suppliers of catering articles are an important stakeholder as well. Currently, KLM has 106 different suppliers covering a total of 430 different products. The supplier performance is an important issue concerning the overall supply chain performance.

Logistic service providers

The logistic service providers are responsible for the physical transport of the catering articles from the central warehouse to the outstations. Currently, KLM uses two LSPs: (1) Kuehne & Nagel for sea freight and (2) Blue Crown for airfreight.

Caterers

The caterer at the outstation is responsible for the operational inventory management at the outstation, for loading the catering load for the homebound flight and for all other catering activities at the outstation including preparing meals.

Authorities

Because of very strict regulations in the airline industry, all different sorts of authorities form an important stakeholder as well. For NSM, the most important authorities are custom authorities all over the world and airline industry specific authorities like IATA and Medina.

Passengers

The last stakeholder is also the most important one: the passenger onboard the flight. All activities of KLM are aimed to satisfy the passenger. By having the right catering articles on board KLM tries to optimize the added value of the inflight experience.

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Appendix F – Key Performance Indicators including explanation

Category		KPI	Unit
Reliability of inventories	1a	Correctness deliveries suppliers (quantity of products)	%
	1b	On time delivery rate suppliers	%
	1c	Discrepancy between actual stock levels and SAP values KCS Warehouse	%
	1d	Correctness deliveries shipments to OS (quantity of products)	%
	1e	On time delivery rate LSP	%
	1f	Discrepancy between actual stock levels and SAP values OS	
	1g	Correctness deliveries to KCS Centrum (quantity of products)	%
	1h	On time delivery rate to KCS Centrum	%
	1i	Discrepancy between actual stock levels and SAP values KCS Centrum	%
Costs	2a	Non-performance costs – Repair transportation costs area[39]	# and €
	2b	Non-performance costs – Repair transportation costs central[40]	# and €
	2c	Non-performance costs – Obsolete products	% and €
	2d	Non-performance costs – Deteriorated products	% and €
	2e	Non-performance costs – Custom fines	€
	2f	Value of inventory – Central warehouse	€
	2g	Value of inventory – Warehouses outstations	€
	2h	Value of inventory – In pipeline	€
	2i	Extra warehousing	Hours
	2j	Normal transportation costs	€
Quality	3a	Accuracy PAX forecast	%
	3b	Accuracy forecast consumption	%
	3c	Accuracy lead time LSP	%
	3d	Quality of supplier delivered products conform spec	%
	3e	Damaged goods due to transportation to OS	%
	3f	Corporate Social Responsibility (CSR) factors	Misc.

[39] *RTC area*: the combined costs spent to repair irregularities in area inventory management.

[40] *RTC central*: the combined costs spent to repair irregularities in central inventory management.

1 Reliability of inventories

Reliability of inventories is a broad term. In this context it is aimed to ensure the right amounts of products at the right locations, including the management of bookings and orders.

1a *Correctness deliveries suppliers (quantity of products)*

This indicator is aimed to assess the supplier's ability to deliver the right quantities, i.e. the quantities corresponding to the central order. It is expressed as a percentage of how much of the order quantity is correct.

1b *On time delivery rate suppliers*

This indicator is aimed to assess the supplier's ability to deliver on time. It is expressed as a percentage of the total number of on time deliveries in a certain time period.

1c *Discrepancy between actual stock levels and SAP values KCS Warehouse*

This indicator is aimed to assess the ability of KCS Warehouse to accurately register and maintain inventories in SAP. It is expressed as the ratio of the difference between actual stock values and SAP-values.

1d *Correctness deliveries shipments to OS (quantity of products)*

This indicator is aimed to assess the area planning's and KCS Warehouse's ability to deliver the right quantities, i.e. the quantities corresponding to the area order. It is expressed as a percentage of how much of the order quantity is correct.

1e *On time delivery rate LSP*

This indicator is aimed to assess the LSP's ability to deliver on time. It is expressed as a percentage of the total number of on time deliveries in a certain time period.

1f *Discrepancy between actual stock levels and SAP values OS*

This indicator is aimed to assess the ability of the caterer to accurately register and maintain inventories in SAP. It is expressed as the ratio of the difference between actual stock values and SAP-values.

1g *Correctness deliveries to KCS Centrum (quantity of products)*

This indicator is aimed to KCS Warehouse's ability to deliver the right quantities, i.e. the quantities corresponding to the KCS Centrum replenishment order. It is expressed as a percentage of how much of the order quantity is correct.

1h *On time delivery rate to KCS Centrum*

This indicator is aimed to assess the KCS Warehouse's ability to deliver on time. It is expressed as a percentage of the total number of on time deliveries in a certain time period.

1i *Discrepancy between actual stock levels and SAP values KCS Centrum*

This indicator is aimed to assess the ability of KCS Centrum to accurately register and maintain inventories in SAP. It is expressed as the ratio of the difference between actual stock values and SAP-values.

2 Costs

These are the costs involved with the catering distribution network used to assess the performance of the network.

2a *Non-performance costs – Repair transportation costs area*

This indicator is aimed to assess the costs concerned with the needed repair shipments to outstations. It is expressed as the total amount of money per period (most likely monthly).

2b *Non-performance costs – Repair transportation costs central*

This indicator is aimed to assess the costs concerned with the needed repair shipments to the central warehouse. It is expressed as the total amount of money per period (most likely monthly).

2c *Non-performance costs – Obsolete products*

This indicator is aimed to assess the ability to react to changes in the product portfolio. It is expressed as the total amount of money of obsolete products, as well as the percentage of different products that became obsolete with respect to the entire product portfolio.

2d *Non-performance costs – Deteriorated products*

This indicator is aimed to assess the ability to deal with products with expiry dates. It is expressed as the total amount of money of deteriorated products, as well as the percentage of the number of articles that became deteriorated with respect to the total amount of articles in stock.

2e *Non-performance costs – Custom fines*

This indicator is aimed to assess the ability to deal with custom regulations. It is expressed as the total amount of money concerned with the fines.

2f *Value of inventory – Central warehouse*

This indicator is aimed to assess to total financial value of inventory in the central warehouse.

2g *Value of inventory – Warehouses outstations*

This indicator is aimed to assess to total financial value of inventory at the outstations.

2h *Value of inventory – In pipeline*

This indicator is aimed to assess to total financial value of inventory in the area pipeline.

2i *Extra warehousing*

This indicator is aimed to assess the extra warehousing activities done by KCS Warehouse. It is expressed as the number of extra hours that are billed in comparison with the standard hours as agreed upon in the contract.

2j *Normal transportation costs*

This indicator is aimed to assess the total costs involved with regular transport of both central shipments as well as area shipments.

3 Quality

Quality in the context of KLM's catering distribution network has been defined with six indicators.

3a *Accuracy PAX forecast*

This indicator is aimed to assess the quality of the PAX forecast that is used for determining desired stock levels for outstations as well as for determining the quantities in replenishment shipments. It is expressed as a percentage of the forecasted PAX numbers versus the actual PAX numbers.

3b *Accuracy forecast consumption*

This indicator is aimed to assess the quality of the consumption forecast that is used for determining desired stock levels for outstations as well as for determining the quantities in replenishment shipments. It is expressed as a percentage of the forecasted consumption versus the actual consumption.

3c *Accuracy lead-time LSP*

This indicator is aimed to assess the quality of the indicated lead-time to outstations as delivered by the LSP. The accuracy has a direct effect on the safety stock levels used for outstations. It is expressed as a percentage of the actual lead-times versus the indicated lead-times.

3d *Quality of supplier delivered products conform spec*

This indicator is aimed to assess the supplier's ability to deliver the quality that is required by KLM. This has to do with both cosmetic quality of products as well as the functional quality. It is expressed as the percentage of how much of the order quality is satisfactory.

3e *Damaged goods due to transportation to OS*

This indicator is aimed to assess the LSP's ability to transport the area shipments without damaging the shipment. It is expressed as a percentage of the shipment that is damaged during transportation.

3f *Corporate Social Responsibility (CSR) factors*

This indicator is aimed to assess the overall ability to manage the distribution network in a sustainable way. For this indicator numerous measurements can be taken, ranging from the carbon footprint of transportation, as well as the quality of the working environment for involved employees.

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Appendix G – Cost overview per type of container per outstation

Origin	Destination Area	Destination City	Container Type 20' or 40'	Destination Port of Discharge	Total Costs (door to door)
Schiphol NL	AFRICA	Accra	20'	Tema, Ghana	1914
Schiphol NL	AFRICA	Accra	40'	Tema, Ghana	3174
Schiphol NL	AFRICA	Cape Town	20'	CPT	2918
Schiphol NL	AFRICA	Cape Town	40'	CPT	4551
Schiphol NL	AFRICA	Dar Es Salaam	20'	DAR	3310
Schiphol NL	AFRICA	Dar Es Salaam	40'	DAR	5344
Schiphol NL	AFRICA	Johannesburg	20'	DUR	3238
Schiphol NL	AFRICA	Johannesburg	40'	DUR	5191
Schiphol NL	AFRICA	Lagos	20'	Tin Can Island	2349
Schiphol NL	AFRICA	Lagos	40'	Tin Can Island	3844
Schiphol NL	AFRICA	Nairobi CY(ICD)	20'	MBA	4022
Schiphol NL	AFRICA	Nairobi CY(ICD)	40'	MBA	6645
Schiphol NL	AFRICA	Nairobi DDU	20'	MBA	4172
Schiphol NL	AFRICA	Nairobi DDU	40'	MBA	6765
Schiphol NL	AMERICA	Atlanta	20'	Savannah	3188
Schiphol NL	AMERICA	Atlanta	40'	Savannah	3744
Schiphol NL	AMERICA	Calgary	20'	Montreal	4096
Schiphol NL	AMERICA	Calgary	40'	Montreal	5388
Schiphol NL	AMERICA	Chicago	20'	NYC/Montreal	3719
Schiphol NL	AMERICA	Chicago	40'	NYC/Montreal	4354
Schiphol NL	AMERICA	Dallas	20'	Houston	3446
Schiphol NL	AMERICA	Dallas	40'	Houston	4002
Schiphol NL	AMERICA	Houston	20'	Houston	2933
Schiphol NL	AMERICA	Houston	40'	Houston	3489
Schiphol NL	AMERICA	Los Angeles	20'	LAX	3268
Schiphol NL	AMERICA	Los Angeles	40'	LAX	3982
Schiphol NL	AMERICA	Montreal	20'	YUL	2439
Schiphol NL	AMERICA	Montreal	40'	YUL	3010
Schiphol NL	AMERICA	New York	20'	NYCT, Howland Hook	3218
Schiphol NL	AMERICA	New York	40'	NYCT, Howland Hook	3774
Schiphol NL	AMERICA	Newark	20'	NYCT, Howland Hook	2946
Schiphol NL	AMERICA	Newark	40'	NYCT, Howland Hook	3502
Schiphol NL	AMERICA	Orlando	20'	MIAMI	2859
Schiphol NL	AMERICA	Orlando	40'	MIAMI	3575
Schiphol NL	AMERICA	Quebec	20'	Montreal	2477
Schiphol NL	AMERICA	Quebec	40'	Montreal	3049
Schiphol NL	AMERICA	San Francisco	20'	OAK	3407
Schiphol NL	AMERICA	San Francisco	40'	OAK	4004
Schiphol NL	AMERICA	Toronto	20'	YYZ	3108
Schiphol NL	AMERICA	Toronto	40'	YYZ	3719
Schiphol NL	AMERICA	Vancouver	20'	Vancouver via Montreal	3702
Schiphol NL	AMERICA	Vancouver	40'	Vancouver via Montreal	4861
Schiphol NL	AMERICA	Vancouver via Cartagena AW	20'	Vancouver via Cartagena AW	3296
Schiphol NL	AMERICA	Vancouver via Cartagena AW	40'	Vancouver via Cartagena AW	4072
Schiphol NL	AMERICA	Washington	20'	ORF	3391
Schiphol NL	AMERICA	Washington	40'	ORF	4186
Schiphol NL	ASIA	Bangkok	20'	BKK	2401
Schiphol NL	ASIA	Bangkok	40'	BKK	3015
Schiphol NL	ASIA	Bejing	20'	TSN	2047
Schiphol NL	ASIA	Bejing	40'	TSN	2495
Schiphol NL	ASIA	Chengdu Shuangliu	20'	CTU	3316
Schiphol NL	ASIA	Chengdu Shuangliu	40'	CTU	4408
Schiphol NL	ASIA	Hangzhou	20'	SHA	1359

Schiphol NL	ASIA	Hangzhou	40'	SHA	1722
Schiphol NL	ASIA	Hong Kong	20'	Port Kelang	1860
Schiphol NL	ASIA	Hong Kong	40'	Port Kelang	2337
Schiphol NL	ASIA	K+N Whse Kuala Lumpur	20'	Port Kelang	1523
Schiphol NL	ASIA	K+N Whse Kuala Lumpur	40'	Port Kelang	1745
Schiphol NL	ASIA	Kuala Lumpur Caterer	20'	PKL	3353
Schiphol NL	ASIA	Kuala Lumpur Caterer	40'	PKL	3769
Schiphol NL	ASIA	Manilla	20'	MNL	2428
Schiphol NL	ASIA	Manilla	40'	MNL	3384
Schiphol NL	ASIA	Osaka	20'	Kobe	2910
Schiphol NL	ASIA	Osaka	40'	Kobe	3924
Schiphol NL	ASIA	Seoul	20'	PUS	2651
Schiphol NL	ASIA	Seoul	40'	PUS	3150
Schiphol NL	ASIA	Shanghai	20'	SHA	1359
Schiphol NL	ASIA	Shanghai	40'	SHA	1722
Schiphol NL	ASIA	Singapore	20'	SIN	1883
Schiphol NL	ASIA	Singapore	40'	SIN	2343
Schiphol NL	ASIA	Taipei	20'	Keelung	2025
Schiphol NL	ASIA	Taipei	40'	Keelung	2574
Schiphol NL	ASIA	Tokyo	20'	TYO	3476
Schiphol NL	ASIA	Tokyo	40'	TYO	4490
Schiphol NL	ASIA	Xiamen	20'	XMN	1187
Schiphol NL	ASIA	Xiamen	40'	XMN	1378
Schiphol NL	ASIA ISC	Delhi	20'	BOM	3797
Schiphol NL	ASIA ISC	Delhi	40'	BOM	5705
Schiphol NL	COI	Bonaire	20'	KRA	3361
Schiphol NL	COI	Bonaire	40'	KRA	4927
Schiphol NL	COI	Curacao	20'	WIS	2751
Schiphol NL	COI	Curacao	40'	WIS	4061
Schiphol NL	COI	Havana	20'	Havana, Cuba	3175
Schiphol NL	COI	Havana	40'	Havana, Cuba	3940
Schiphol NL	COI	Guayaquil	20'	Guayaquil, Equador	2481
Schiphol NL	COI	Guayaquil	40'	Guayaquil, Equador	3461
Schiphol NL	COI	Paramaribo	20'	PMB	4233
Schiphol NL	COI	Paramaribo	40'	PMB	5853
Schiphol NL	Latam	Buenos Aires	20'	Buenos Aires, Argentine	2607
Schiphol NL	Latam	Buenos Aires	40'	Buenos Aires, Argentine	3391
Schiphol NL	Latam	Lima	20'	Callao	2965
Schiphol NL	Latam	Lima	40'	Callao	5127
Schiphol NL	Latam	Panama	20'	Manzanillo	3117
Schiphol NL	Latam	Panama	40'	Manzanillo	4175
Schiphol NL	Latam	Rio de Janeiro	20'	Rio	3539
Schiphol NL	Latam	Rio de Janeiro	40'	Rio	4119