AIRBUS FASTENERS’ SUPPLY CHAIN OPTIMIZATION

How to stock, prepare and distribute in the most efficient way?

Master Thesis

At Lunds Tekniska Högskola

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PREFACE

This Master Thesis has been performed at Airbus S.A.S as the last part of my Master of Science in Engineering at Lund Institute of Technology, Sweden. The Thesis has been carried out in collaboration with the Department of Industrial Management and Logistics at Lund Institute of Technology and within the Power8 Supply Chain & Logistics team, Airbus Central Entity, Toulouse.

I would like to start by thanking Claude Bitouzet for having accepted me as a trainee within Airbus. Furthermore I would like to thank particularly Eduardo Dominguez Puerta, my supervisor all along this internship, for its help and the time he spent explaining and helping me. I appreciated especially the working atmosphere within the team managed by Stephane Mirc, making the project even more enjoyable. I also want to give a special thank to Stig-Arne Mattson for feedbacks and help during this thesis. Finally I would like to express gratitude to all the personnel at Airbus for their contribution by taking time for answering questions.

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ABSTRACTS

Title: Airbus Fasteners’ Supply Chain Optimization – How to stock, prepare and distribute in the most efficient way

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Purpose: Mapping the current fasteners’ logistics practices within two major Airbus Plants in order to determine zones of improvements and then building proposals able to streamline the processes focusing on cost efficiency and supply chain integration.

Method: A qualitative and quantitative study based on interviews, best practices and visits gathered during visits on different production sites but also current literature

Recommendations: Fasteners have to be treated as low value parts with limited strategic importance requiring a reduction of the handling costs and a more efficient distribution. Implementing a VMI solution under responsibility of a lead service provider constitutes part of the recommendations described. Such outsourcing policy necessitates also a Decision Support Tool helping Airbus to keep control on the physical logistics

Key words: Kanban, Freestock, VMI, European Lead Service Provider, Break bulks, WIP, Assembly kits, BOM, PFEP
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1. INTRODUCTION

This chapter will provide the reader with an understanding of the background to the project as well as a clear picture of the author’s objectives. In order to define the purpose of this Master Thesis, it is critical to share the underlying problem analysis with the reader.

1.1 Background

In a world where global products are produced in a global production system and are sold in the global market place, the supply chain becomes major contributor to the corporate success\(^1\). Indeed the global competition is not based anymore on a challenge between manufacturing companies but mainly on a challenge between manufacturing companies supply chain\(^2\), which consists in focusing on rapid response to customers needs at low costs. Therefore in order to stay competitive in reaching the wide spread customers in an effective and cost efficient way, more importance has been given to the area of logistics.

Managing the supply chain aims at challenging constantly the corporate strategy by setting a new environment where cost savings must be done whenever an opportunity appears. Consequently costs which do not add any value to the final product have to be chased and reduced: outsourcing has become a widely accepted practice as companies concentrate on their core activity\(^3\), savings in inventory holding costs are performed through smaller stock levels, deliveries from the supplier to the point of use must be optimized, etc. This is the time of continuous improvement and “lean” thinking!

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\(^1\) Schary, P. B. & Sjøtt-Larsen, T. (2001) *Managing the Global Supply Chain*


\(^3\) Schary, P. B. & Sjøtt-Larsen, T. (2001) *Managing the Global Supply Chain*
Chapter 1 - Introduction

As a matter of fact AIRBUS is facing a deteriorating cash and profit position following problems to deliver its products on time and additional costs. In order to keep on competing in the aeronautical market, a turnaround project (Power) has been launched aiming at implementing a new business model with lighter and more cost-efficient processes, a refocus of the industrial base on core activities, the development of large industrial partners and a truly integrated organization.

In this strategic reconsideration, the supply chain optimization must play a major role and might highlight relevant improvements on the current processes.

1.2 Problem analysis

Among all the opportunities of savings, the Supply Chain & Logistics area is covering a wide range of possibilities since the procurement supply chain accounts for 80% of the product costs. Therefore several modules were created, each one contributing to the final proposal of the global project. Thus this Master Thesis will concentrate its research on logistics solutions for Batch Products within the Physical Logistics module. Furthermore speaking about batch products means dealing with raw materials, fasteners, detail parts, hardware, etc. Consequently the scope of this thesis will be focusing on the fasteners supply chain.

Even though dealing with fasteners seems meaningless, Boeing experience through the 787’s project has proved that any shortage or quality problem in the fasteners supply can lead to significant delays and economical consequences.

The future solutions shall define the most efficient way to deliver goods from supplier to the point of consumption on time, quality and at the lowest costs. It involves a perfect knowledge of the existing processes in order to determine where potential savings can occur. Hence such a scope will concern the inventory part, the

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4 About Power, AIRBUS SAS
5 Ibid.
6 Barnett, N. Smart Buying module leader, Airbus S.A.S, 2006
management of the service providers, the material flows, and the delivery solutions used in the Supplier-Warehouse and Warehouse-Point of Use flows. The Production department will thus be our customer and this area is already under continuous improvement to make it run under the lean manufacturing concepts. Logistics decisions will influence the results of such project since they will be applied in order to improve the whole efficiency of the company. Therefore an interface with the Lean Manufacturing might also be required since the delivery to the point of consumption must be coordinated with the production planning.

In order to reach solutions on above stated problems, the following issues should be analyzed:

- How manufacturing performances can be supported and secured?
- Which methods could be used for decreasing logistics and holding costs?
- How should Airbus gain in productivity by working on logistics improvements?
- In which way should the Make or Buy policy be defined? Where should be the limit of ownership between the company and its suppliers?

### 1.3 Purpose

- To map current practices “As is” within two major Airbus Plants & FAL’s, Hamburg and Saint Eloi production sites, concerning the fasteners logistics
- To analyse and determine zones of improvements in the Kanban and Freestock processes from the preparation to the delivery to the points of consumption
- To build “to be” proposals able to streamline the deliveries focusing on the right physical flow of fasteners with most reduced lead time, with their advantages/drawbacks, risks and deployment conditions

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Wallace, J. “Mad dash to finish 787 gets trickier”, Seattle Post-Intelligence, May 2007
1.4 **Focus and Delimitations**

As the project was mainly based on Airbus France and Airbus Germany data (Saint Eloi and Hamburg sites), it will give general recommendations that could be benchmarked with the case of Airbus UK or Airbus Spain. However it will highlight the main differences in logistics processes from one entity to the other which constitute obstacles to the global efficiency of the company. Nevertheless the study aims at locating the points of improvement and at giving an overview of a possible optimization of the logistics solutions concerning fasteners (stock, preparation, distribution). On the long view Airbus should run as a single company applying the same logistics policy whether it be in Germany, UK, Spain or France.

However the inventory policy will not be in the scope of this thesis. This study does not aim at determining any new safety stock or re-ordering point but should analyse the different steps of the logistics process from the supplier to the Point of Use. These analyses must lead to some proposals eliminating any waste in the productivity and offering major savings in the logistics approach of the company. The optimization of the inventory levels will mainly concern the eventual buffer stocks within the production units and the reduction of the WIP levels.

Finally the reader has to keep in mind that our customers are the manufacturing units and consequently the logistics solutions must be adapted to their specifications. Indeed the eventual significant savings determined by our scenario have to be also converted into manufacturing savings.

1.5 **Target groups**

This thesis is mainly addressed to Airbus employees, students, teachers and other people within the academic world that have an interest in logistics and supply chain strategy.

Apart from this main target, this report may be useful to other students or companies who would have to work on a similar optimization of any kind of logistics solutions.
1.6 Definitions

In this report few concepts and abbreviations are used that might be unknown to the reader. These concepts are both Airbus definitions and technical terminology. To facilitate the reading of this report, and to avoid misunderstandings, a list defining all the terms used I all along this report is available in the glossary.
2. METHODOLOGY

This chapter presents to the reader how the research has been performed. The choices of methods are thereafter motivated with their advantages and drawbacks. Validity, objectivity and reliability of the analysis will be discussed as part of the conclusion.

2.1 Methodology approaches

Being able to achieve a business research, consulting or investigation project involves from the author a clear idea of how to get a global picture of the reality. Therefore assumptions are required in order to investigate, clarify and explain the problematic. These assumptions are defining the scientific approach of the study. According to Arbnor I. and Bjerke B., nowadays there are three methodological approaches operating: the analytical, the system and the actors’ approaches.

Concerning the analytical approach, the assumption is that the whole is the sum of its parts. Indeed in order to solve a problem, researchers have to divide it into several sub-problems, the global picture being always the sum of its parts. Consequently the knowledge created using this kind of approach is independent of the observer since it is represented by judgments independent of any individual subjective experience. As an example building a soccer team based on an analytical approach would involve the selection of the best goalkeeper, the best striker, etc.

Contrary to the previous notion, the system approach considers that the whole differs from the sum of its parts. By that meaning the reader should understand that not only the sub-problems but also their interactions might influence the global

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9 Arbnor, I. & Bjerke, B. (1997), Methodology for creating business knowledge
10 Ibid.
11 Ibid.
comprehension of a problem. Accordingly the overall system can result in better or worse effects than the sum of its part. Using the system approach in the previous example, the soccer coach would not only have to take into account the football skills of his players but also the characteristics of the opponent team, the field or the relationships between players.

The last way to get onto a research project is the actors’ approach. In that case the reality depends on its observers and this view gives rise to subjectivity. The global interpretation will differ from person to person and the knowledge developed becomes individual. The team spirit would then be part of the selection criteria for building the best soccer team, which would vary from coach to coach following their own point of view.

The approach of this Master Thesis can be summed up in one sentence: “The only way to gain lasting competitive advantage is to leverage your capabilities around the world so that the company as a whole is greater than the sum of its parts” (Whitman, D. (1994), C.E.O. of Whirlpool Corporation). The system view is indeed the most suitable way and can be motivated by the definition of a supply chain: this is both a network and a system. The sequence of connection among organisational units constitutes this network while the interdependence of activities, organization and processes contributes to its systemic properties. Every single action in one part of the system will affect other parts. As an example the supplier lead-time influences the amount of inventory held within the system.

In order to complete a proper analysis of this project, a well understanding of the interconnections between the different actors will be compulsory. Then the whole will be studied as a single problem in order to get the optimal result, which requires an

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12 Arbnor, I. & Bjerke, B. (1997), Methodology for creating business knowledge
13 Arbnor, I. & Bjärke, B. (1994), Företagskonomisk metodlär
14 Arbnor, I. & Bjerke, B. (1997), Methodology for creating business knowledge
adaption of its subdivisions to each other. Corresponding to this approach, I will work with the notion of total costs involving that any savings can be reported to any area of the supply chain (procurement, manufacturing, etc). Hence this work will be influenced by the procurement and manufacturing requirements in order to determine logistics solutions.

The reader should be aware that because of interviews and external helps, the actors approach must also be considered. Indeed the interpreter affects the information received in form of preconceived notions or unconscious interpretation. Nevertheless I tried to decrease the risk of using it but could not eliminate it.

2.2 Choice of methodology

Once the purpose of the research is fully understood, the way of proceeding must be determined. This thesis being performed while taking part in the Power\textsuperscript{8} project, data gathered all along its advancement will constitute relevant information for our study. The main constraint will unfortunately be the absence of concrete results since every measure taken or proposed is currently under process.

2.2.1 Induction, deduction and abduction

There are usually two ways of getting onto a problem when working on a research project, the induction and the deduction\textsuperscript{16}. The difference between both approaches is whether the research starts with an empirical observation or with hypothesis derived from theories. The inductive method is used when no theoretical studies are required before starting the research; theory is then developed based on patterns and structures from the empirical data. The disadvantage of using such way of proceeding is that it is rather difficult to keep objectivity without any influence of earlier knowledge. The second approach consists in developing hypothesises from theories; their reliability could then be tested through experiences on empirical samples. The problem with the

\textsuperscript{16} Wallén, G. (1996). \textit{Vetenskapsteori och Forskningsmetodik}
deductive method is that the researcher only tests hypotheses that he believes in, out of the box, facts are hard to discover\textsuperscript{17}.

Initially project started using a deductive method by analysing the current situation with the existing theory concerning supply chain strategy. But the study has also been based on empirical observations and personal analysis, theory being sometimes scarce due to the compelled innovative changes in particular parts.

\subsection*{2.2.2 Qualitative versus quantitative}

Typical research methods can be either qualitative or quantitative and were both used all along this project. A qualitative investigation relies on reasons beyond various aspects of behaviour and facts that can not be proved numerically while a quantitative analysis involves data that can be measured or quantified. This project covers logistics solutions from the supplier to the points of consumption and will consequently deal with different type of information. Qualitative facts based on interviews and visits will interact with quantitative data such as database coming from the SAP system. Optimizing a supply chain must hence combine the two methods in order to add different perspectives to the problematic.

\subsection*{2.3 Research structure}

The first chapter defines the problematic and the delimitations of our study and helps the reader to understand the issues of such project. The theoretical section combined with the description of the current situation constitutes the base of our analysis, which will later contribute to formulate general recommendations. The global understanding of the current situation was facilitated by many visits to the different production sites. Recommendations do not have the ambition to set up a precise strategy but more to present orientations leading to a more cost effective organization.

\textsuperscript{17} Jacobsen. (2000). \textit{Vad hur och Varför?}
2.3.1 Choice of theoretical references

The theoretical references were either chosen by the writer himself or advised by Eduardo Dominguez Puerta in order to get a global understanding of the issue. These data have been renewed constantly in order to answer questions being raised all along the study. The chapter presenting the different notions and models is mainly based on literature and scientific articles. It aims at covering the parts of the supply chain playing a key role in its optimization and will therefore concern classification of items and suppliers, types of outsourcing strategies or material and administrative flows.

2.3.2 Interviews & visits

Official or improvised interviews were led all along the project with specialists in different areas of the supply chain. By improvised interviews, the reader should understand information and advices coming from the different members of the project Power. Furthermore as a member of this project, the author got the opportunity to visit Hamburg, Broughton and Toulouse sites. Observing the processes and the current practices in the production areas instead of making its own opinion through databases or presentation constitutes an ideal approach and makes the understanding much easier. However the report could loose in objectivity by only basing information sources on this type of data. Interviews and visits were either performed with Airbus employees or service providers and therefore were always influenced by the corporate culture.

2.3.3 Data collection

Many data were collected through the SAP system in order to get a complete understanding of the inventory policy, the place of the fasteners among the other commodities, the role of the suppliers and the service providers. The SAP system is the main source of quantitative up-to-date data and contributes to the relevance of this thesis. Concerning the qualitative information, most of them are shared on an e-room and helped to understand processes and to follow the project’s advancement.
2.4 Reliability and sources criticism

2.4.1 Reliability and validity

Insuring the reliability of a research project involves that the writer guarantees that any haphazard mistake do not come up through its measurements or assertions. Results might be irrelevant if using wrong or unsuitable measuring tool and in many cases this point is hard to figure out. As an example the reliability of an interview depends strongly on the interviewed person who interprets and understands the questions in his own way. The manner the interviewer formulates its questions has therefore a strong influence on the answer he will get. The best way of securing the reliability in this case is to standardize the interview methods.

The validity of a measure means that the author measured exactly what he wanted to. It becomes considerably difficult when it deals with people as object of an investigation. Risks that the interviewer or the object of the interview may be influenced by some external parameter are high and could therefore modify the results. Letting an outsider analysing the correspondence between what is considered and what is measured should improve the validity of the results. Furthermore tools and methods must be tested on samples belonging to the category of data that will later be studied. Such result is then compared to existing models in order to evaluate their validity.

2.4.2 Project reliability and sources criticism

Reliability and validity of the results have been improved through the different visits of the concerned production sites. The information collected through interviews, Airbus documents and meetings were hence verified on the field and modified if necessary. Due to the large variety of processes mainly caused by the separation of the company into four entities and the huge amount of data treated, it is really hard to get an exact knowledge of the global Airbus logistics. The only way to improve is to visit, analyse and talk with the different actors so that the project focuses constantly on its objectives. However as the research has been conducted at a global level, any detailed
solution will not be proposed. Such project would need to be carried out on a very long period in order to get a perfect knowledge of the whole Airbus supply chain and this was impossible in our case. Nevertheless, the author tried to come up with general recommendations focused on the main objectives. A deeper study would be required at each level if applying them. These recommendations define the orientation the company should choose and the strategy to apply in order to perform savings and integrating the whole supply chain into a more cost effective process.

Reliability and validity of all the qualitative data have been maintained at a high level for the previous reasons despite the absence of real detailed analysis proper at each work station or supplier. However, the quantitative data were harder to analyse because of the diversity of systems and processes. Depending on Germany or France, measuring tools and processes are different. Hence it is really hard to obtain the same level of information concerning quantities of parts consumed, stored or delivered and to generalize them at a global corporate level. As a consequence, results were considered as trends, but precise enough to propose improvements.

2.4.3 Objectivity

Keeping an objective point of view was hard since the author was fully integrated to an Airbus project team. Nevertheless, due to the objectives of global changes set up by the project, every actor needed to analyse and think as an outsider in order to propose innovative solutions. As a matter of fact, Procurement and Manufacturing were like customers waiting for our proposals, whether they would be accepted or not. Furthermore, a member of each entity (UK, Germany, UK and France) took part in the project, not only for reducing risks of political conflicts but also in order to keep a certain degree of objectivity.
3. THEORITICAL FRAME OF REFERENCES

This chapter presents the theoretical models that will be later used for analysing the collected data. As an introduction, notions about the supply chain objectives will be described followed by different methods for managing suppliers. Concerning this part, the notion of VMI will be explained. Dealing with problems of supply chain efficiency will conclude this theoretical section.

3.1 The Supply Chain objectives

In a constant evolving global market, companies have been all throwing themselves into costs hunt in order to build the most cost effective supply chain processes. Indeed the chain must be managed to respond rapidly to change in the market and customer requests. Beyond this competition and financial concerns press to reduce operating costs and investments in assets. Because an organization cannot be efficient and competitive in every area, outsourcing represents the best strategy to get rid of the non-value added activities and relevant savings can therefore be achieved. When the non-core activities can be committed to suppliers or service providers, the core competencies giving competitive advantage must be owned. Then following the evolution of competition and new technologies, new activities become the core and others can be shifted to other partners.18

Consequently new organisations have been set up in order to manage in the most optimal way all the supply chain, including the main company, its suppliers and service providers, in an interorganizational manner. It aims at eliminating the redundancies created by barriers between stages by integrating operations to make the system as a whole more responsive to customers and to reduce the cost of product flow as far as possible.

possible\textsuperscript{19}. Hence different types of collaborations appeared depending on the role an actor is playing within the supply chain.

But speaking about integration means also dealing with different sources of conflicts and trying to balance them. As an example to get the most profit, a company must have at least four main objectives: provide the best customer service at the lowest production costs, the lowest inventory investment and the lowest distribution costs. However these objectives create conflict among marketing, production, and finance departments and this is where coordination is required. Conflicts have to be balanced to minimize the total of all the costs involved and maximize customer service consistent with the goal of the organization\textsuperscript{20}. The Bullwhip effect illustrates the need of coordination between partners: the farther we are in the chain from the final customer, the higher is the order variability and then every stage being optimized doesn’t mean that the whole would be optimized\textsuperscript{21}.

In a more general way, the supply chain strategy has three components: structure, process and relationship. Structure deals with the choice of partners, defining activities and locating them inside the organization. Processes involve the sequence of activities and the information and products flows (lead times, inventory or ordering management). Relationships define the connections between organizations\textsuperscript{22}. Cost savings occur by playing on the characteristics of all these parameters. This Master Thesis will follow this structure in order to define a scenario.

To conclude a central actor of the supply chain, the purchasing function, has to be presented since it is in charge of obtaining material inputs for the operating systems

\begin{itemize}
\item \textsuperscript{19} Schary, P. B. & Skjøtt-Larsen, T. (2001) Managing the Global Supply Chain
\item \textsuperscript{20} Tony Arnold, J. R. Chapman, S. N. & Clive, L. M. (2007), Introduction to Materials Management
\item \textsuperscript{21} Pimor, Y. (2004), Logistique: Production, Distribution & Soutien
\item \textsuperscript{22} Schary, P. B. & Skjøtt-Larsen, T. (2001) Managing the Global Supply Chain
\end{itemize}
(raw material, fasteners, equipment, etc). Its basic objectives can be summarized as follows:

1. To determine the quality and the quantity and when an item is needed
2. To obtain a reasonable price
3. To maintain good relations with suppliers
4. To maintain sources of supply
5. To be knowledgeable about prices, new products, and new services that become available

Even if this study will mainly deal with the points 1 and 3 among all these tasks, the reader has to be aware that optimizing a supply chain requires a close look at how costs of the purchasing can be reduced and how the performance can be improved (Make or Buy, suppliers performance, packaging, etc).

3.2 Suppliers and service providers management

3.2.1 Make or Buy?

How to decide either to make or to buy? This is a recurrent question which has to be balanced since it can orient firms towards strategies that can have long-term consequences. Nowadays outsourcing has become a common practice especially in the logistical area and many service providers propose to perform tasks such as warehousing, transport or handling. As I explained previously, the make-or-buy decision is closely linked to the differentiation in core and non-core activities and any operations bringing no competitive advantage should be outsourced in order to concentrate resources on the core ones.

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23 Stevenson, W. J. (1997), *Production/Operations Management*

Number of factors is usually considered when looking at the make or buy strategy:\(^25\):

1. **Available capacity.** If an organization has available capacity, it makes sense to produce or perform a service in house. The additional costs would be relatively small compared with those required to buy items or subcontract services.

2. **Expertise.** If a firm lacks of experience to perform a job, buying might be a reasonable alternative. The desire for efficiency and superior performance is achieved through specialization, furthermore outsourcing in this case increase the return on capital by using assets without owning them\(^26\).

3. **Quality consideration.** Firms that specialize can usually offer higher quality than an organization can obtain itself, unless the ability to closely monitor quality is available.

4. **The nature of demand.** If demand for an item is high and steady, the organization is often better off doing the work itself, however wide fluctuation or small orders are better handled by others who can combine orders from multiple sources.

5. **Cost.** Any cost savings achieved from buying or making must be weighted against the preceding factors.

This externalization of services is facilitated by the improvements in technology and information systems making communication and data sharing through the whole organization easier. However risks that suppliers change allegiance or competitors might develop an access to the same resources exist and logically the overall result depends on the partners’ performance (lead time, quality, cost, etc). This is why a firm might sometimes choose to perform part of the process itself and let others handled the rest in order to maintain flexibility and prevent loss of subcontractors\(^27\)…

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\(^{25}\) Stevenson, W. J. (1997), *Production/Operations Management*


\(^{27}\) Stevenson, W. J. (1997), *Production/Operations Management*
3.2.2 Goods and suppliers characterization: ABC classification & the Kraljic model

Since a company can work with several suppliers, it is important to create the proper relationship with each of them (see next part). Indeed spending too much time with a minor supplier represents a wrong utilization of its own resources. Thus the right way to differentiate them is to classify them and the products they deliver. Furthermore such a classification of products can help to determine the proper way to handle goods.

**ABC classification**

This method can be used either for a supplier classification or for a product classification. It consists in separating these elements into 3 categories A, B and C following specific parameters such as annual consumption value, volume, costs or clutter\(^\text{28}\). As the Italian statistician, named Pareto, noticed, regarding the criterion chosen, 20% of the elements studied will represent 80% of the total value.

Concerning the suppliers’ differentiation, they have to be considered in terms of economical weight within the supply chain such as the purchased volume they represent for the buyer\(^\text{29}\). Consequently those with a strong economical influence will be categorized as A-providers, those with a lower weight as B-providers, etc. Thus the buyer will try to own as much resources as possible within the system of the supplier considered as the most valuable.

Products classification plays a relevant role in order to avoid any overstock or shortage of items involving potential breakdowns in the manufacturing process. It will determine the articles requiring a strong follow-up with a proper replenishment policy, help to define inventory criteria and cost savings strategies and get rid of the dead

\(^{28}\) Nakhla M. (2006), *L'essentiel du management industriel*

\(^{29}\) Bjørnland D. & Persson G. (2003), *Logistik för konkurrenskraft*
The most relevant criterion used to define the economical weight of a group of products is the volume value (demand x value), and following the Pareto rule, the classes A, B and C are respectively representing 10%, 30% and 60% of the total stock. Once this analysis is done, this is important to define the right adjustment between service level and cost. Inventories of the A and B categories must be systematically reduced because of their high economical value but the service level must therefore be maintained at a high rate. C-class items, because of their low economical value, must be managed at a minimum cost by optimizing ordering formula and handling techniques since the main objective for this category is to avoid shortages. Another method generally used is the frequency analysis where fast movers, which have to be stored close to the picking area, are separated from the slow-movers. But this analysis does not define any economical influence.

The main critics of this tool are that it does not give any information about the profitability of the product. An A-class item could have a low contribution to the benefit while a C-class one would add high value to the final product.

**The Kraljic model**

Kraljic developed a model for classifying and setting purchasing strategy. Purchased items are divided into four groups based on two dimensions: strategic importance and the difficulty in managing the purchasing process. The strategic importance of a purchased item deals with competence factors such as how close it is to the core competencies of the buyer, economic factors like its volume and value and image factors concerning how the purchase influences the brand name. Factors in managing the purchase situations are more about product characteristics, supply market characteristics or risk and uncertainty. Purchases are then divided into four categories: leverage, non-critical, bottleneck and strategic (see Figure 3.1)\(^{31}\).

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\(^{30}\) Nakhla M. (2006), *L'essentiel du management industriel*

Chapter 3 - Theoretical frame of reference

Figure 3.1 – Kraljic’s matrix

Non-critical items are easy to manage with low strategic importance related to the buying firm’s activity. There are many suppliers providing this kind of good which is high standardized. The purchase activity can be usually outsourced to a third-party provider.

Leverage purchases are easy to manage but strategically important to the customer. The buying firm orders in large quantities and consequently the cheapest provider is contracted. As the negotiating position is strong because of the wide number of suppliers, prices can be brought down and costs reduced. Furthermore concentrating purchases at one main supplier might enable discounts.

Bottleneck items are purchased in small quantities and are often critical for the activity. They are difficult to manage and the customer is in a weak position for negotiating. The point is to secure the availability of those products. As they have a low strategic importance and are ordered in small quantities, it is not unusual to keep the inventory within the customer system.

The strategic category encompasses products with a strong strategic importance and difficult to manage. The buying firm has to work in collaboration with its suppliers in

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33 Van Weele, A. (2002), Purchasing and Supply Chain Management
a close relationship by involving them in the product development and similar operations.

Once this task done, a firm can get a clear understanding of the differences between goods and information about how the purchase activity should be organized. However such a classification can be complicated to perform if a company deals with suppliers providing goods from different categories.

### 3.2.3 Customer / Supplier relationship

Once the suppliers and the goods or services they are providing have been classified, the whole supply chain has then to be integrated. In order to have the most efficient supply chain, suppliers have to be managed in the right manner. Many criteria have to be considered in order to define the proper organization and part of the make-or-buy decision is on how to structure sourcing. Hence the management of the preferred suppliers’ relationships needs to reflect the characteristics of the materials or components involved and the marketplace in which a company operates.

Having a complete integration within the supply chain means identifying the appropriate relationship to the environment and the product or service exchanged. Moreover the number of providers a firm decides to source plays a key role in the outsourcing strategy. A review of the different types of relationship combined with the number of contracted suppliers is following:\(^{34,35}\):

1. **Adversarial relationship.** Suppliers are held at arm’s length with a growing amount of business. There is a little face-to-face and the key order-winner is price. This type of relationship is usually established in the commodity markets, with multiple suppliers, low asset specificity and little market uncertainty.

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\(^{34}\) Schary, P. B. & Skjøtt-Larsen, T. (2001) *Managing the Global Supply Chain*

2. **Preferred suppliers.** Such a relationship is suitable for providing goods and services that are of medium asset specificity and can be considered as complementary to the core competencies of the buying firm. However the product purchased has low strategic importance for the customer. Suppliers with equivalent product specifications, quality and price are limited and the customer will choose a few suppliers as preferred sources. Usually contracts are established for a medium-term and relations are developed in term of information sharing and require sound management by customers.

3. **Single sourcing.** Concerned goods or services are directly linked to the core competencies of the buying firm. They are provided by a single source for a specified period of time and are of medium to high levels of asset specificity. A similar type of relationship called *parallel sourcing* is characterized by using a single source for a component of one model at one plant while another source is used for the same model at another plant. It combines asset specificity and a commitment to long-term single source relationships and still allows a high degree of competition among suppliers.

4. **Network sourcing.** It is characterized by a tiered supply structure with cross-exchange of staff between buyer and supplier. There is a relative high asset specificity and risk sharing. Furthermore suppliers are involved in design and innovation. Consequently this is a high trustful relationship between the customer and the provider’s network.

5. **Strategic alliances.** Here the whole customer/supplier relationship increased depth and breath. A prerequisite of more cooperative relationships is a dramatic reduction in the supplier base and recognition by customers of the fact that their costs, quality conformance levels and lead times are partly within the processes of their supplier (ex: third party logistics providers).

6. **Backward integration.** The partnership changes ownership leading to the full sharing of information and the transfer of goals and culture.
Chapter 3 - Theoretical frame of reference

Once the context defined, a firm needs a model to assist in managing with several types of supplier relationships. Bensaou (1999) created a model based on specific investments made by both buyers and suppliers enabling the managers to define the most appropriate structure. Customer-specific investments in a relationship can concern buildings, infrastructures, tooling required for the supplier’s product or operations. They can even encompass training and education of the supplier’s personnel. Supplier-specific investments may include physical assets such as warehouses or specialized tools and equipment dedicated to the customer’s need. They could also include product design or training of their own personnel in order to satisfy the customer demand. Therefore the Bensaou model classified four types of buyer-supplier relationships depending on the two previous dimensions: 

- Market exchange
- Captive buyer
- Captive supplier
- Strategic partnership

Figure 3.2 – The Bensaou’s matrix

Market exchange. This category is characterized by highly standardized products, which are manufactured with well-known techniques. Thus there is no need of high investments from both suppliers and customers and as the dependency between the two parties is non-existent, changes in contracts might be frequent.

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37 Ibid.
Chapter 3 - Theoretical frame of reference

Captive buyer. This type of relationship involves complex products based on well-known and stable technologies. Customers must invest in the supplier’s specific equipment in order to use the provided goods, making changes of contract much more difficult. Therefore suppliers are highly qualified and can hold a dominant position on the buyer since they are only few large and well established.

Captive suppliers make specific investments in order to keep and win customers but they are constantly under a risk if switching. This dependency comes from the technology owned by the customer and required to manufacture complex products and its access to the final market. Buyers often try to contract several suppliers in order to maintain competition and bring down prices.

Strategic partnership. As the complexity of the buyer’s product is high and suppliers’ products are highly customized, a strong involvement and investment in the relationship is required from both sides.

Firms can’t manage with only one design; they have at first to identify the type of relationship that matches the competitive conditions surrounding the product or the service required and second, to design an appropriate management model38.

3.2.4 Third-party logistics (3PL)

Berglund (1999) defined third-party logistics as “Activities carried out by logistics service provider on behalf of a shipper and consisting of at least management and execution of transportation and warehousing (if warehousing is part of the process)”39. This is in fact a high level of outsourcing operational logistics activities involving mutual trust and open information. The operations of both parties are therefore integrated in interfaces between information systems and interorganizational teams and the asset specificity is relatively high. Usually the chosen logistics providers may invest in dedicated facilities and even in personnel training. Thus services become

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39 Ibid.
tailored to the customer’s requirements and a provider can sometimes be fully responsible of the personnel, equipment and warehouses owned by its client.

A higher degree of cooperation has appeared recently where a broad range of management and logistics services is offered including not only the traditional operations such as warehousing, transportation, value-adding services, but also managing and optimizing the customer’s supply chain, IT competencies and global coverage. This collaboration, named fourth-party logistics, is usually characterized by the designation of a lead logistics provider, which will provide a complete package of logistics services.

As mentioned previously in the section “Make or buy?”, logistics activities are outsourced in order to concentrate the most vital sources on the business. Outsourcing these operations to a third-party provider brings many benefits to a company: conversion of fixed costs to variable costs, economics of scale and scope, creation of a leaner and more flexible organization, faster access to new markets and distribution channels. Nevertheless such strategy might involve risks and investments coming from the customer. By releasing one part of its activities, a company gets exposed to problems of dependency on the firm now performing these tasks mainly because data and information must be shared between both parties. Limiting those risks requires costs of control in order to keep an eye on the provider’s performances.

### 3.3 Vendor Managed Inventory

Vendor Managed Inventory, or VMI, aims at eliminating any unnecessary cost within the inventory part of the supply chain. In that case, the supplier relieves its customer from its duties and takes over the responsibility of managing the inventory.

Usually the only information a supplier knows is the orders its customers have sent, which is not sufficient for matching the purchases with the real need in its customers’

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production. In that case ownership, holding and management of the inventory are performed within the same organization while in a VMI system they are not necessary hold by the same side but shared between supplier and client. In this concept the customer informs its supplier of the stock levels required and the demand and then based on these data, the latter maintains the inventory in the customer’s facility. VMI can be defined as a collaboration between a supplier and a customer in order to optimize the efficiency of the supply chain concerning resources, cash holding and cost reduction. The supplier is responsible for filling and keeping the inventory levels within the limits of the mutual agreement. This model aims at increasing the replenishment frequencies and eliminating the unnecessary operations, on a supplier perspective the VMI is considered as a strategic factor for winning market shares.

However there are different levels of cooperation associated to the notion of VMI. Some argues that EDI-communication (Electronic Data Interchange) is a necessary condition when others admit that a low level of integration can be sufficient. Depending on the level of integration supplier / customer and how much responsibility a provider owns in the partnership, three models are presented on the figure 3.3.

![Figure 3.3 - Different types of VMI](image)

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41 Ståhl Elvander, M. (2004), *A theoretical mapping of the VMI concept*

42 Mattsson, S.A. (2002), *Logistik i försörjningskedjor*
Chapter 3 - Theoretical frame of reference

Managed inventory in collaboration. The supplier manages the customer’s inventory based on the current stock level and the client’s demand forecasting. He is therefore responsible for inputting the purchased orders within the customer’s system. In this type of partnership the buyer pays the operative inventory management task of the supplier and control can be maintained on its work by dividing responsibilities. Indeed the customer owns the warehouse and is thus responsible of inventory and shortage costs, whereas the supplier charges him at each delivery\textsuperscript{43}.

Vendor Managed Replenishment. The client still owns the inventory and makes available to the supplier the min and max levels, which are determined knowing the service level required by the customer and estimating how much value needs to be stored. In this way the supplier is free to plan its deliveries\textsuperscript{44}.

VMI managed under consignment. In that case the supplier owns the inventory and manages the inventory at the customer facility. Thus the supplier takes over the whole responsibility of the inventory management and is completely free; the buyer is then only charged whenever a product leaves the storage. The only restriction is that the service level has been agreed in advance between both parties. In an optimal way, the supplier could divide its inventory between its warehouse and the customer’s one\textsuperscript{45}.

Such collaboration requires an integration of the management systems and usually buying firms ask their suppliers to adapt themselves to their MRP. Thus providers either adopt a new system, which requires new qualification of their personnel and investment, or try to interface their current system to their customer’s one. Another solution is transferring data to each other via EDI-communication. Then information such as consumption, forecasts, stock level, lead times or quality can be shared. The advantage of this method is that inventory is managed based on this share of information.

\textsuperscript{43} Mattsson, S.A. (2002), Logistik i försörjningskedjor

\textsuperscript{44} Ibid.

\textsuperscript{45} Ibid.
On a customer point of view the VMI presents many advantages, and reduced inventory is obviously one of the most compelling arguments for VMI. The availability and share of data involves a reduction in the safety stock and thus an increase in the stock renewal frequencies. Furthermore as the supplier owns the inventory, holding costs are largely cut, and all the inventory activities such as picking, kitting, packaging, etc are taken over under the supplier responsibility. On the other hand the customer might invest in IT, and above all share confidential information, which make him dependant on its provider.

3.4 Supply Chain profitability

On the road to the efficiency and the integration, many criteria require to be focused on in order to keep or win competitive advantages. Thus two parameters can characterize the material flow efficiency: the internal and external efficiencies. The first deals with how internal processes are handled while the latter is more about the adaptation the external environment. Improving the internal efficiency involves reducing wastes and non-value adding activities among the resource utilization, storage facilities or transport costs. Parameters such as delivery lead time, delivery capabilities or delivery flexibility influence the external efficiency. These two criteria will be analyzed through the notion of delivery service for the second one and capital and logistics costs for the first one.

3.4.1 Delivery service

This notion encompasses the quality of the suppliers’ logistics activities and the customer’s one. The different parameters presented below characterize the delivery service.

Inventory availability can be defined as the probability that an item is physically available in the warehouse. This notion is mainly used as a dimensioning parameter, for as example the safety stock. Two types of measures characterize this notion. The first

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46 Mattsson, S.A. (2002), Logistik i försörjningskedjor
47 Axsäter, S. (1991), Lagertyning
one counts the number of inventory turnovers without any shortage but does not specify how long the shortage can last, the second is the proportion of the demand that can be directly supplied from the inventory.

*Inventory service level* characterizes the real delivery capacity of an inventory and shows how good a company is in performing deliveries that have been ordered by its customer. It can also measure the number of orders remaining compared to the entire quantity of orders required. Compared to the previous notion used for a dimensioning purpose, this criterion reflects the real performance of an inventory.

*On Time Delivery (OTD)* measures the delivery performances of a supplier. This indicator can be easily understood with the following formula:

\[
\text{OTD} \, (\%) = \frac{\text{Number of order lines completely delivered within the on-time window in the period}}{\text{Total number of planned order lines within the same period}}
\]

*Delivery dependability* measures whether a supplier delivers the right product in the right amount with the required quality. It can be determined as the number of customer’s orders without any notification compared to the total delivered orders\(^{48}\).

*Delivery flexibility* indicates the firm ability to adapt itself to new situation, which are more cost efficient. However this parameter is harder to measure and it is sometimes easier to work on the volume or the products flexibility.

### 3.4.2 Costs analysis

Many costs are occurring at each step of the supply chain, each one influencing in a different way the total balance cost. In the integration process of the global supply chain it is therefore important to differentiate them when seeking for cost savings. A company does not only try to reduce costs but has also to free as much cash as it can not only for its own profit but also for investing in new market or in new processes. This review will present the main costs used for logistics decision and how to classify them when determining the potential savings.

\(^{48}\) Mattsson, S.A. (2002), *Logistik i försörjningskedjur*
**Holding costs versus logistics costs**

High inventories involve frozen capital immobilized by the stored goods and a logistics cost required for handling them. Reducing inventory is then one of the common solutions that a company can apply for freeing cash but such a decision involves an improvement of the service level. Stocks can be lower when replenishment frequencies are higher. Thus when reducing one parameter the other will increase and so will the costs. An Economic-Order Quantity (EOQ) can be determined has the right balance between holding and logistics costs.

Without speaking about inventory policy, savings can be made at each step of the process when productivity, integration and efficiency are optimized and this is why each cost needs to be well characterized\(^\text{49}\).

*Item cost* is the price paid for a purchased item and consequently characterizes the total stock value stored within a warehouse\(^\text{50}\).

*Transport and handling costs.** Goods moved in small quantities cost more to move per unit than those moved in large quantities. However, moving large batches implies higher inventory\(^\text{51}\). It obviously encompasses the transportation but also costs associated to all the operations linked to an order: picking, kitting, packing, uploading, receiving, unpacking, etc.

*Holding costs* are covering three dimensions: capital costs, storage costs and risk costs.

1. *Capital costs* represent the capital tied-up to the inventory since money invested in is not available for other uses and as such represents a lost opportunity cost\(^\text{52}\).

2. *Storage costs* are the expenses in the local’s rent, shelves, handling equipment, personnel salaries and insurance. It is based on interest rates.

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\(^{49}\) Purchasing costs are not described in this section. It only deals with costs occurring through the logistical process.


\(^{51}\) Ibid.

\(^{52}\) Ibid.
3. Risk costs. The risks in carrying inventory are: obsolescence (lost of product value resulting from a model or style change or technological development) generating dead stocks that might be scrapped, damage, pilferage and deterioration (inventory that rots or dissipates in storage or whose shelf life is limited). Costs of shortage can occur when an item is not in the warehouse if ordered. It can result in income reduction and production breakdown.

The logistics costs are actually the transport and handling costs and will increase with the replenishment frequency. As written previously holding costs will be reduced with a lower inventory but deliveries frequency will then be higher. A Total Costs Analysis (TAC) can result in an improvement of the global expenses by balancing those two parameters. However savings must also be differentiated depending on which lever is used.

**Cash & EBIT savings**

The reader has to be aware that depending where and how savings are made will influence the availability of the resources coming from these cost reductions. Indeed cost savings are divided into cash and EBIT savings. Earnings Before Interest and Taxes (EBIT) indicate a company’s earning power from ongoing operations, equal to earnings before deduction of interests payments and income taxes.

Hence some savings will generate liquidity, which was frozen in assets, directly available for further investments while others, named EBIT savings, will come from improvements in the productivity, in the processes or through a better integration. As an example on one hand in the inventory cost reduction processes, the amount of items removed from the inventory constitutes the cash savings since they were

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equivalent to frozen assets. On the other hand it will result in a reduction of the holding costs considered as an EBIT saving.

3.5 Material flow management

Although notions of costs, suppliers’ partnership or inventory policies have been defined, such project might be irrelevant without any analysis of the physical supply chain. It includes all the activities involved in moving goods, from the supplier to the beginning of the production process, and from the end of the production process to the consumer. The activities involved are usually transportation, distribution inventory, warehousing, packaging, materials handling or order entry. There are indeed potential savings within the way logistics activity is performed and several concepts have been established in order to optimize these physical flows. Actually the supply chain of necessity is becoming a market-driven organization, responding to market pressure\textsuperscript{55}. Therefore the supply chain anticipating the customer, named \textit{push} orientation, and placing inventory at the point of sale, is shifting to an orientation where the customer order \textit{pulls} the product through the supply chain. Orientation strategies and optimization projects are thus all pushing towards processes as “pulled” as possible.

3.5.1 JIT & Kanban

Just In Time (JIT) is a concept developed in Japan within Toyota by Taiichi Ohno aiming at eliminating any source of waste in processes\textsuperscript{56}. This notion is always linked to the Lean Manufacturing orientation. It mainly deals with bringing material and components to the specific point and time where they would be used, in the right amount to match the production schedule. The main advantages generated by this practice are reduced inventory and factory space, reduced material handling and quality control through smaller lot sizes. This is a real pulled orientation where the needs of a step are fulfilled by the previous one and consequently there should not be

\textsuperscript{55}Schary, P. B. & Skjøtt-Larsen, T. (2001) \textit{Managing the Global Supply Chain}

\textsuperscript{56}Nakhla M. (2006), \textit{L’essentiel du management industriel}
any buffer or intermediate storage. However it remains risks of potential interruptions and requires stable production, close coordination between manufacturer, carrier and supplier, including telecommunication skills. Indeed the true value of JIT is that it reveals problems hidden by inventory and buffers so that they can be solved.

As the customer pulls the production, every step is working for satisfying the needs of the next one. This demand is characterized by a document named Kanban (signal card). It is a signaling system originally using cards to indicate a need to replenish inventory at a user’s station. Kanban systems usually have very small lot sizes and short lead-times. It is essentially a two-bin type of inventory replenished semiautomatically when they reach a predetermined level. Nowadays this system is usually electronic and the Kanban card is defined with a code bar. Hence a logistics operator is in charge of performing a milk run at a determined frequency consisting in scanning (with a code bar reader) all the empty bins so that a replenishment order is sent through the information system. Therefore a Kanban system can only be efficient within a JIT strategy when its associated quantities are optimized.

A brief scheme of the process is presented on the figure below.

Figure 3.4 – Kanban process

58 Mattsson, S.A. (2002), Logistik i försörjningskedjor


3.5.2 Forecasting & planning

This part will not deal with any kind of mathematical formula but mainly with the approach a company might need to determine its demand in raw materials, fasteners, equipments, etc. Nowadays forecasting and production planning are determined by the Material Requirement Planning (MRP), which is connected through the information system to the procurement, finance and transport activities. It actually determines inventory status and release orders for purchasing, scheduling them on vendor lead times. The aerospace sector is not a mass production industry and a company does not forecast how many aircrafts it is going to sell but plan the demand on a certain period of time. In other words, the aircraft industry is not a build-to-stock industry. Orders for new aircrafts are announced months prior to manufacture and an aircraft manufacturer has time to ramp up its operations to match those orders. Nevertheless problems appear when components’ demand such as fasteners or raw material must be planned. This is where forecasting operations might be performed.

Before going on farther in the explanations, the reader should know that a Bill Of Material (B.O.M.) is associated to each product. This BOM is simply a list of all the components required to manufacture an aircraft and is associated to the MRP. Consequently knowing the demand and the BOM, a company should be able to determine all its needs and when they are required. However its components are always evolving and re-engineered for making the production processes more efficient. This creates risks of obsolete stocks of unused parts and provokes higher inventory levels involving the need of a different solution to the BOM if the systems are not updated on time according to the technical modifications.

Thus depending on how advanced a program and how stable the production is, another method is also chosen: forecasting based on the consumption. This type of planning requires obviously a stabilized demand and does not work if the project is at

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its beginning. Furthermore this can lead to overstock or interruption in the production in case of any lack.

3.5.3 Different type of flows

Airbus has defined different logistics standard flows which are currently associated to each part involved in any process. Depending on the product or commodity characteristics (big volumes, parts, consumable, equipment, work package) and the constraints associated (under development, part number under concession, crash critical, etc), an optimal logistics flow can be recommended. There are four different kinds of flows within this classification: Supplier-Warehouse-Consumer (SWC), Supplier-Warehouse-Kanban (SWK), Supplier-Consumer (SC) and Supplier-Kanban (SK). Their clear significations are described on the figure below.\textsuperscript{61}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{different_logistics_flows.png}
\caption{Different logistics flows}
\end{figure}

\textsuperscript{61} Airbus Procurement Department (2007), Lean Supply Chain
Direct Flows from Supplier to Consumer

1. *SC: Delivery from Supplier to Consumer.* Deliveries are made in accordance with delivery Call-up<sup>62</sup> requirements, corresponding to the Schedule Production Plan of the specific workstation or Work Order. No stock is maintained; the goods are consumed directly by the Work Order. Contractual Agreements may cover specific terms of delivery.

2. *SK: Supplier Kanban.* Based on Call-ups triggered by the consumer, either electronically (e.g. barcoding) or manually. Deliveries are made directly to the place of delivery specified in accordance with the delivery Call Up requirements.

Flows to Consumer via Warehouse

3. *SWC: Supplier-Warehouse-Consumer.* Deliveries are made into the warehouse in accordance with either the Manufacturing Plan or an AIP (Procurement) driven plan, from MRP calculation, by re-order point or by stochastic calculation. Deliveries to the consumer are triggered by MRP reservations.

4. *SWK: Supplier-Warehouse-Kanban-Consumer.* Deliveries are made into the warehouse in accordance with either the Manufacturing Plan or an AIP (Procurement) driven plan, from MRP calculation, by re-order point or by stochastic calculation. Deliveries to the Kanban module are triggered by the consumer, either electronically (e.g. barcoding) or manually.

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<sup>62</sup> Delivery Call Ups represent either fixed quantities or fixed frequencies and flexible quantities of Items agreed between the Purchaser and the Supplier and based upon consumption rate / economical batch manufacturing
Chapter 3 - Theoretical frame of reference
4. GENERAL INFORMATION ABOUT AIRBUS S.A.S

This part aims at giving to the reader an overview of the company and the aeronautical sector in order to understand the scope of the study. As an introduction Airbus activity will be described, followed by a short part concerning its history. It will be concluded with the description of the aeronautical market.

4.1 About AIRBUS S.A.S

AIRBUS S.A.S is a European aircraft manufacturer, belonging to EADS, whose headquarter (Central Entity) is based in Toulouse, France. The firm is divided into four entities, Airbus UK, Airbus Spain, Airbus Germany and Airbus France, split up into 16 sites. Each of those sites is producing complete aircraft sections, which are then transferred to the Final Assembly Lines located in Hamburg and Toulouse. Under the authority of Tom Enders, new CEO of AIRBUS, the company, which employs about 57000 people around the world (including France, Spain, the UK, Germany, North America, China, Japan and Russia)\(^63\), made a turnover of € 26 billion in 2006\(^64\). More precisely 7753 orders have been received in total, 4858 have been delivered and 4637 are still in operation\(^65\). In 2007, 294 aircrafts have been delivered and AIRBUS registered 713 orders\(^66\).

The company is regularly achieving over 50% of all new airliners orders and deliveries worldwide and offers a large range of products including the world’s best selling aircraft family, the A320 family\(^67\). The products are grouped into four families: the Single-Aisle A320 family (including A318, A319, A320 and A321), the Wide-Body

\(^{63}\) The Airbus Way, AIRBUS, August 2007

\(^{64}\) [http://www.airbus.com/en/corporate/people/] (link)

\(^{65}\) [http://www.airbus.com/odxml/orders_and_deliveries.xls](link)

\(^{66}\) Ibid.

\(^{67}\) The Airbus Way, AIRBUS, August 2007
A300/A310 family, the Long-Range A330/A340/A350 family and the Ultra Long-Range A380 family\(^8\). Some of those products arrived at the end of their life cycle and consequently the last A300 was delivered on the 12\(^{th}\) of July 2007\(^9\). Others are still on the project phase like the A350 XWB which will be available starting 2013.

AIRBUS plays also a role in the Defense industry through the company AIRBUS Military S.A.S created in January 1999 with the A400M whose first delivery is planned for 2009\(^{10}\). This strategy has stabilized the very cyclic demand for commercial aircrafts.

This overview shows the different commercial aircraft families, their freighter variants such as the Beluga and the new military portfolio along with the corresponding moment of introduction to the market:

\[\text{Figure 4.1 - Airbus aircraft variety}^{71}\]


\(^{71}\) A400M – Standard Presentation, AIRBUS, 2006
4.2 Historical background and exemplary work share

Back in 1970, AIRBUS started as a Franco-German consortium called AIRBUS Industries, the goal being to fill a niche, with the A300\textsuperscript{72}, in the American-dominated aviation industry. British Aerospace and CASA of Spain later joined the consortium. Since 2001, AIRBUS is a single and fully integrated company incorporated under French law as a Simplified Joint Stock Company or S.A.S. (Société par Actions Simplifiées). BAE Systems\textsuperscript{73} sold its 20\% share in 2006, which means that AIRBUS is now fully owned by EADS.

As a result of the division of AIRBUS into four entities, each aircraft is built according to an international work share. To give an example, this figure shows the work share of the A380:

![Figure 4.2 - Work share AIRBUS A380\textsuperscript{74}](image)

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\textsuperscript{72} Braunberger, G. (2006) *Airbus gegen Boeing: Wirtschaftskrieg der Giganten*

\textsuperscript{73} BAE Systems was founded in 1999 after the merger of British Aerospace (BAe) and Marconi Electronic Systems (MES).

\textsuperscript{74} *A380 Freighter – the new benchmark for large Freighters*, AIRBUS, May 2005
It is with the A380, the biggest commercial aircraft in aviation history, that the company now completed its product portfolio. The double-decked aircraft is able to carry up to 555 passengers in a standard three-class configuration and up to 850 in a single-class configuration and is supposed to compete with the American Boeing 747, which has been the largest aircraft for about 35 years.75

4.3 Aircraft manufacturing and supply chains

The development of aircraft models is very expensive. Therefore global sourcing and collaborative development is very important in this sector. The manufacturers try to share the development costs with their suppliers. AIRBUS is going to increase outsourcing from 30% to around 50% of the development and production for the new model A350XWB. Boeing outsourced 65% of the 787’s production.76

Furthermore the role of the customer in the aviation sector is different to other industries. In other industries supply chains are demand driven and the manufacturer should have the visibility of point-of-sales data so that production meets the actual customer needs. Concerning our case, AIRBUS and Boeing have already orders for the next coming years and they can schedule the production long time in advance so that the demand side of the supply chain is not that important for the actual production. Even though, the customer needs are still important during the production phase, e.g. the customer can choose its individual cabin equipment. This has a big influence on the production because a different cabin equipment can cause a complete different electrical wiring.

Aircraft are produced on assembly lines. But because of the size of planes, assembly lines as known from the automotive industry are not suitable for planes. Therefore there are several stations on an aircraft assembly line and the planes are moved from station to station within a certain amount of time (e.g. the Boeing 777 moves every

75http://www.airbus.com/en/presscentre/pressreleases/pressreleases_items/27_Apr_05_A380TakeOff.html
76 Judge, E. *Airbus to seek cost cuts by outsourcing*, Times, 14th November 2006
three days to a new station\textsuperscript{78}). A particular workload is done on each station on the aircraft. To reduce the lead-time of the production, AIRBUS started to execute work on different parts of the aircraft at the same time and on the same station.

For example, different teams on the single aisle FAL work at the same time on the interior furnishing and in the cockpit. This caused a lead-time reduction of 33\%\textsuperscript{79}.

4.4 Concerned production sites

The project Power\textsuperscript{8} introduced in the part 1.1 encompasses the entirety of the production sites and FALs. Working on the fasteners’ logistics solutions within the same scope as the Power\textsuperscript{8} one would make this master thesis enormous. This is why this project will only deal with the production sites of Saint Eloi and the FAL located in Hamburg.

Saint Eloi site is specialized in developing, manufacturing, assembling and testing the pylons, which are linking the engines to the wing of an aircraft. This is furthermore the first European center of hard metal machining, mainly oriented on steel and titanium. The site is the eldest of the Toulouse area and it took part in many projects such as Armagnac, Caravelle, Concorde or the different Airbus aircraft families. Three types of activity are performed in the plant:

1. \textit{Machining and assembling hard metal parts}. Saint Eloi manufactures parts and mechanical sub-assemblies of pylons and nacelles by working on hard metals such as Titanium or Steel.

2. \textit{Forming and assembling metal sheets}.

3. \textit{Assembling the pylons}. Saint Eloi has under its responsibility the final assembly and the delivery of the pylons to the FALs. The assembly operation is performed in a flexible workshop where the primary and the secondary


\textsuperscript{79} One (Airbus News For Airbus People), AIRBUS S.A.S., July 2006
structures are realised. The pylon is then equipped with all the systems linking the aircraft to the engine (hydraulic system, fuel, air conditioning)\(^8\).

**Hamburg**, headquarters of Airbus Deutschland and the largest site in Germany, employs more than 10,000 people and plays a decisive role in the development and engineering of all Airbus aircraft. Final assembly takes place here for three of the four members of the A320 Family - the A318, A319 and A321. Hamburg is headquarters of the Centre of Excellence for cabin and cargo customisation, and also is the site where A300/A310, and A320 Family aircraft have their cabin interiors fitted and where they are painted ready for final delivery. Furthermore Hamburg carries out the complete interior furnishing of the A380 cabins and painting of the aircraft. In addition, final acceptance and delivery of A380s to customers in Europe and the Middle East takes place in Hamburg.

In manufacturing, Hamburg's many years of experience goes into fuselage structural assembly and systems installation, making it part of the Centre of Excellence forward and aft fuselages. Hamburg produces complete fuselage sections for the A380, which are shipped to France on a specially-built roll-on, roll-off ferry.

5. DESCRIPTION OF THE CURRENT SITUATION

This part aims at describing the fasteners’ supply chain defined at Saint Eloi and Hamburg factories. As an introduction fasteners notion will be defined and they will be briefly characterized economically and strategically. Their physical flows will be detailed followed by a short presentation of the ordering & forecasting and inventory policies. This chapter will conclude on the AIRBUS sourcing strategy not only regarding suppliers but also service providers.

5.1 Fasteners definition and their management strategy

5.1.1 Fasteners in AIRBUS

Fasteners are defined as a commodity of components used in many manufacturing industries. They are basically hardware devices that mechanically join or affix two or more objects together. Concretely parts like screws, screw nuts, clips, bolts, etc, are considered as fasteners, and they are furthermore provided at a really low price. Requirements for this kind of components are usually low which makes their availability to their customers truly high. However a risk remains in potential shortages. Fasteners are mainly made with aluminium and their availability is therefore closely linked to the global resources of this raw material and its current price. As an example Boeing has been victim of shortages in fasteners due to a global over consumption of aluminium. The production is mainly located in Asia and large wholesalers are often contracted as suppliers for the client companies. As a consequence to this high availability and the large market segment related to the fasteners, many companies are competing, mainly on effective logistics solutions in order to minimize their customers’ costs since administration and logistics constitute the main expenses for this commodity.

The fasteners commodity is part of the Power project and the logistics solutions associated to these components must be analyzed and optimized in order to reach the required cost efficiency. Objectives are to minimize the supplier base, to consolidate volumes, to develop and prioritize suppliers with low total costs.

In order to characterize this commodity among all those involved in the processes, Saint Eloi data are exposed as an example their main characteristics can be applied to the rest of the assembling processes. Indeed the reader should go through this description in order to get a global understanding of the differences, advantages and drawbacks of the logistics strategies adopted by the different Airbus entities, the purpose being to determine a global policy for the whole company. These data come from the ERP (SAP system) and represent parts stored and consumed during the year 2006 as baseline. A tool called BW (Business Warehouse Data) can then generate tables of parts depending on parameters such as storing warehouse, physical flow, commodity, Airbus site, vendor, etc.

| Number of PN  | 2930 |
| Number of movements | 38107 |
| Stock value | XXXXX€ |
| Number of suppliers | 58 |
| Number of PN managed in Kanban | 2142 |

Figure 5.1 - Information about fasteners in Airbus Saint Eloi

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82 Wallace, J. “Mad dash to finish 787 gets trickier”, Seattle Post-Intelligencer, May 2007
83 PN is the Part Number of an item
84 A movement is associated to the reception of a certain quantity of items at the Point of Use on SAP.
85 SAP extraction of data from 2006 in Saint Eloi
Chapter 5 - Description of the current situation

As presented in the table above almost 75% of the fasteners are managed under a Kanban system. This comment oriented the project to another limitation of the scope. Starting from now the study will only concern the optimization of the logistics solutions of fasteners managed under the Kanban or Freestock method. But this previous notification imposes to define the notion of Freestock (Kanban was defined in the part 3.5.1) and the Airbus policy regarding these systems.

5.1.2 Freestock definition

Freestock is a method similar to the Kanban system, for managing item quantities, strictly developed in Airbus Germany. There are few differences between the two processes but the main management methods, material and administrative flows are identical. Thus part of all the goods involved in the manufacturing processes is available in Freestock and is identified as “bulk material”. They are at the free disposal of the workers who can serve themselves at the freestock warehouse of their workshop. Compared to the amount of fasteners managed under Kanban in Saint Eloi, 80% are sorted as Freestock parts in Hamburg.

An externally sourced component can be considered as Freestock part if it is classified as a serial part with a price below five euro and/or if the concerned item does not have any quantity defined on the BOM (tape, adhesive, cables, etc). This process has been set up in order to reduce the production orders related to the withdrawals from the stores, to reduce the administrative effort concerning the collection of components in store, transport, or disposition, to diminish the staff, to increase the production flexibility, to react in a better way to the volatility of material requirements and to optimize the manufacturing tolerances. The process will be described more precisely all along the part 5.2 concerning material flows.

86 Business Process Re-engineering Internal Logistics. AIRBUS SAS, July 2006
87 SAP extraction of data from 2006 in Hamburg
88 Freestock Logistics. AIRBUS Germany, June 2007
5.1.3 Kanban strategy

The notion has been treated in the part 3.5.1 but there are some specified requirements proper to Airbus. The Kanban system is used for good supply to the shop-floor and concerns parts such as fasteners required in a regular basis continually provided in small quantities to the work centre. All the master data and transaction information is maintained before any operation in order to reduce to the minimum the data entries to perform during the production processes. As it was mentioned a Kanban system is characterized by a card which has a status at any time. An event occurs for the system when the Kanban status changes, triggering different processes depending on the Kanban configuration.

5.2 Administrative and material flows

As the administrative and material flows will influence and play a major role in defining a new supply chain, they are presented below. In order to locate zones of improvement the Kanban and Freestock processes must be described and understood. These two self service stock managements are driven by the consumption which triggers the replenishment process. The administrative flow being really similar in both cases, it will be introduced at the end of this part.

5.2.1 Freestock and Kanban specificity

This system is characterized by a twinbins box. Every reference, also called Part Number (PN), is available to the worker in a box divided into two parts one onto the other, the bottom bin being at the free disposal. Once this box empty, the worker has to pull a plate located in-between the two boxes in order to release the upper stock.
Chapter 5 - Description of the current situation

Each item managed under Freestock has a bar code for its optical identification presenting the PN, the bin number and the quantity per bin. In addition there is a 16-digit number below the bar code indicating the hangar, the store, the bin and the material number:

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01  04  2041  110220388
hangar  store  bin  material number
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All these information make the delivery to the Point of Use easier for the person in charge of this task.

The Kanban system has been built on the same structure. A Kanban box is composed of two containers: the reserve side and the loose side as shown on the picture below. The later is directly at the disposal of every worker whereas the first one contains parts still inside a bag and a bar code. When there is no part anymore in the loose side, the

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89 Freestock Logistics. AIRBUS Germany. June 2007
90 Ibid.
Chapter 5 - Description of the current situation

worker opens the bag stored in the reserve side, puts the parts in the accessible container and throws the bar code in a tag box which later will be checked. A tag showing the same bar code as the reserve side is also assigned onto the Kanban box with the PN written on. Some goods have specific replenishment parameters. In those cases there could be several bags stored in the reserve side but such information is indicated on the tag in the form of a min or a max level.

Figure 5.4 – Kanban store

5.2.2 Freestock and Kanban flows

Whether in Hamburg or in Saint Eloi there is a central warehouse dispatching goods all around its concerned area. These warehouses can be either only concentrated on the fasteners or devoted to several commodities. There is furthermore, concerning Hamburg, an intermediate warehouse or dispatch zone between the central warehouse and the points of use. This storage enables the unloading of goods before dispatching them to the different destinations.

The demand of any good is driven by a Work Order (WO), which is a description of one or several activities to be executed at a specific time in the shop floor. A WO mentions when and where the task must be performed as a result of a MRP run and

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91 Kanban in Airbus France. AIRBUS France. June 2005
of the line and the station scheduling. Thus the physical result of the WO is made to order and not to stock. Furthermore the WO generates a list of components required for performing an operation. In Saint Eloi this picking list is also used for preparing a Mobile Service Unit (MSU) on site. A MSU is a trolley containing goods available at the factory warehouse (equipment, material, detailed parts, etc) required for performing a pylon’s assembly operation which is then delivered at the concerned work station. However the fasteners managed under Kanban process are already available at the work station and therefore can not be dispatched on these MSUs. The WO is usually generated eight days before starting the production order so that there are always one MSU use at the work station and one stored ready to start the next assembly\textsuperscript{92}. In Germany, these MSUs are prepared at the central warehouse and before being delivered to the work station they go through the dispatch centre presented previously. In addition to this MSU, workers get the required fasteners at the Kanban or Freestock station by using the list generated by the WO. The picking list indicates not only the type of components required but also where the worker can find them by displaying the Kanban module, the box and the PN for fasteners.

These Kanban and Freestock modules are indeed a group of boxes located close to the working area where they are needed. Workers have to move from their station to

\textsuperscript{92} Philippe Dulac. Logistics Engineer. AIRBUS France. 06/07/2007

\textsuperscript{93} Internal Logistics – GOOD ISSUES. AIRBUS SAS. April 2007
the modules in order to get the fasteners required to perform their task. The appendix 2 presents the Kanban modules location at the Saint Eloi factory. A logistician, also called milk runner in Airbus France, is in charge of checking all the bins by using a bar code reader. All the Kanban with empty reserve sides, Freestock with empty upper containers or boxes with min level reached must be scanned in order to launch the replenishment process. This operator can be helped in this task using the tag box where all the tags indicating empty containers have been thrown. Furthermore the milk runner performs the replenishment of the previous identified empty boxes and dispatch new bags on the reserve side for the Kanban or fills the upper part of the Freestock bins. Depending on cadences and PN a milk run is usually organized minimum once a week whether in France or in Germany. This signal triggered by scanning an empty box is registered within the MRP and converted into replenishment order for the central warehouses.

The same process is performed at the central warehouses. Once the replenishment order received through the MRP, the right quantities are picked in the concerned stores, dispatched, prepared, packaged and then sent to the factories. Stocks are maintained between a min and a max level and when the re-order point reached, an order of replenishment is launched to the suppliers. Hence MRP does not only schedule, calculate and display the production planning and requirements, it also manages the inventory levels so that purchasing orders can be sent to the suppliers when needed.

Indeed every single operation performed is registered in the Production system in order to insure a proper traceability of every single move. This traceability is not only imposed by Airbus for better performances but also by every Aviation Administrations for quality requirements. Thus when a worker goes and picks the right quantity of items at the central warehouse referring to a Kanban replenishment order, a bar code is zipped so that the system knows that goods have been withdrawn from this location. Packages and goods are also identified by the document’s bar code.

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94 Aviation Administrations must be able to know the origin of every components constituting an aircraft.
which travels with them. Every dropping place is identified by a panel with bar code, called “tracking station”. Thereby in every load or dumping of packages or goods in those “tracking stations”, associated bar codes are scanned and registered in the tracking system. And a cost is moreover associated to such transaction.

Thus 100% of the fasteners encompassed in our scope are managed under a SWK flow, the warehousing zone being the central warehouse.

Figure 5.6 – Freestock process

5.3 Ordering & forecasting strategies and the inventory management

As written at the beginning of this master thesis, the purpose is not to reduce the inventory levels in the warehouses but to optimize the Airbus policy and the logistics processes. Thus minimizing the stock on production sites is one of the goals of this project and knowing how sizes of the Kanban or Freestock boxes are determined constitutes relevant information on the way of a leaner supply chain of fasteners.

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95 Internal Logistics – Good Issues. AIRBUS France. April 2006
96 Freestock Logistics. AIRBUS Germany. June 2007
5.3.1 Ordering & Forecasting

Suppliers always deliver to the central warehouses pre-determined quantities agreed on the contract linking them to Airbus. Nevertheless in case of fluctuations in the demand, quantities are regularly reviewed to adapt them to the production needs. The size determination of the Kanban or Freestock batches is performed in the central warehouse-production site loop, the objectives being to have as less stock as possible distributed into the factory. In addition to the distribution of optimized quantities, the level of stocks available at the points of use depends also on their traceability described in the previous part. A proper traceability avoids any new and useless replenishment order when the concerned article is already within the production perimeter, this information being unknown. Quantities of fasteners for a Kanban or Freestock unit are always defined using the past consumption of the concerned work station.

In the process described in the previous part, once the empty boxes scanned for triggering a replenishment order, another operation for consolidating and calculating needs is launched. Data are processed through a MRP’s specific software for determining a dynamic short-term forecast of the needs and an average of the consumed goods’ quantity is calculated. The last 4 months consumption is divided by the quantity of manufactured aircrafts within the same period. Then this average is multiplied by the manufactured aircrafts’ quantity planned for the next month in order to define forecasted consumption quantities for this period.
The BOM, mentioned in the part 3.5.2, does not help to calculate the future needs of fasteners based on the demand but only releases the information necessary for printing the picking lists. Parts involved in the manufacturing processes are continuously re-engineered even if the program has reached a stable phase. Modifying these technical specifications is expected to improve the production efficiency by making the operations easier to perform. Therefore the BOM is always under improvement and often disconnected to the reality of the manufacturing side. Forecasts based on the BOM, in the current Airbus system, could be source of a high level of obsolete stock. Moreover modifications on the assemblies are also occurring at the work stations level. Indeed depending on the assembly configuration, a worker can modify the type of fastener fixed on a part. As an example a longer or wider screw can replace the original one that would not fit in the assembly. Screws are classified as following DAN 8-5-6, the last number indicating its length. In our case, a worker is authorized to replace a screw by another one being one unit longer or shorter than the original one. Such modification is registered on a quality note later given to his management. However if modifications are more than one unit, request must be studied and validated by the Material Committee imposing the Engineering Standard Material Definition for quality requirements. Unfortunately even though a change of...

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97 Internal Logistics – As Is, AIRBUS SAS
fastener in an assembly is registered, there is no real follow up of the modification frequencies on the BOM, especially in the first case. Forecasts based on this tool are hence difficult to determine since no efficient updating process of the manufacturing changes has been set up.

5.3.2 Inventory Management

Here again, the inventory management will not concern the central warehouses but the goods stored as Kanban or Freestock at the production area. In order to limit the amount of items stored around the work stations, every box should contain enough parts to last one month. Indeed even if fasteners are low value parts, the aerospace industry uses such an amount that neglecting the inventory strategy of this commodity could freeze enough capital to penalize the company.

Once parts have been received on the production site and dispatched to the work stations, they are considered as Work In Progress (WIP). They are no longer classified according to their PN in the SAP system. In Germany all the Freestock parts are classified as WIP stock. Thus both upper and lower bins constituting one Freestock box are out of the ERP and allocated to the calculation of the number of fasteners required to build one aircraft. This number is indeed an average based on the number of fasteners consumed as WIP compared to the number of aircrafts produced in a given period. On the other hand only the loose side of a Kanban box is considered as WIP. The reserve side which is still conserved in a bag is registered in the SAP system. The determination of the consumption is therefore more precise in the French process with only the loose side taken into account for quantities determination since these bins are at the free disposal of the workers and exposed to risks of over-consumption. But regarding to the German method, transactions are fewer since once the Freestock bins released in the production area there is no more operation and change of status within the Airbus ERP system.
5.4 Sourcing strategy

Because of its history Airbus has never lead a real policy of rationalization of its sourcing strategy. Furthermore because of some politics orientations some suppliers have always been imposed without any real performance evaluation. Thus purchasing officers have a large range of suppliers at their disposal. In 2001, when the four entities were integrated into one single company, each one conserved its own suppliers. Regarding to the fasteners sourcing, Airbus is provided today by more than 150 suppliers for UK, Germany, Spain and France. In our scope 59 suppliers are contracted for the 2930 PN consumed at Saint Eloi factory, in Hamburg they are 82 providing the site in fasteners. Their influence on the amount of PN distributed is variable and they are selected at the beginning of each new program looking at prices, performances and delivery criteria. As an example, the graph below displays the amount of PN covered by each supplier in Hamburg. For a question of industrial privacy, each one has been identified by a number.

Hence the range of PN delivered by a supplier can vary from 1 to 530. And this is approximately the same distribution in Airbus France. Moreover and this will be treated later similar part can be provided by two or more providers.
In order to evaluate its suppliers’ performances, Airbus has developed two criteria similar to those described in the part 3.4.1.

$D_i$ is associated to the schedule adherence and therefore to the OTD criteria. But the firm has furthermore introduced a delivery window linked to this parameter. On-Time, early, late and outstanding deliveries are distinguished since the three last one can influence either the inventory level or the production capabilities. Indeed such deliveries could cause overstock or breakdowns in the manufacturing processes. The figure below presents these different classifications.

![Figure 5.9 – Delivery window](image)

$R_i$ characterizes suppliers through their quality performances. At every delivery a quality investigation is done checking the quantity received at the warehouse compared to the one ordered, comparing the parts to their technical specifications and detecting any eventual defect. Each non valid delivery is then registered and associated to its supplier.

### 5.5 AIRBUS’ service providers

Whether in Germany or in France, the company has decided to outsource its physical logistics operations in order to concentrate itself on its core-competencies: building aircrafts. This decision is not proper to the fasteners commodity since service providers took over this activity for a relevant range of parts delivered to the points of consumption. Thus the interface between the suppliers and the production areas is under the total responsibility of several service providers. Working in Airbus’ facilities, they are in charge of insuring the right reception of delivered goods, their storage by maintaining proper inventory levels and their distribution until the area where they

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99 Delivery Adherence Reporting User’s Guide. AIRBUS SAS. May 2006
will be used. Such activity is evaluated in term of service level. This decision involved a close collaboration between Airbus and its service providers mainly illustrated by a share of the information systems in both sides. Nevertheless there are some differences of organization concerning this issue for the two entities mainly illustrated by the outsourcing of the physical logistics to a different company depending on the country. Consequently the two cases will be treated separately.

5.5.1 Saint Eloi

Airbus France has only contracted one service provider, which will be identified with the letter A, for managing the fasteners’ physical logistics. The contract covers the reception, the storage and the distribution of the goods to the work stations. Nevertheless stocks are still owned by Airbus and its Information System is also used by the provider. All the fasteners consumed in the Toulouse area are received and stored in a single warehouse located close by the different production areas of this zone. Due to the absence of any automated devices within the facility, every task is performed manually. But above all the same service provider manages the provision of fasteners for the whole French entity at another warehouse situated in the Saint-Nazaire facilities (North West of France). This means that the middle and long term planning of the fasteners’ ordering and the ordering point dimensioning are determined at Saint-Nazaire which also takes deliveries at its facility. Communications between suppliers and A are transferred through the EDI technology. Goods, which are required at the Toulouse production sites, are then sent to the concerned regional warehouse, requiring a new reception task.\[100\]

Consequently the unloading, reception and loading operations are performed both in Saint-Nazaire and in Toulouse. Once arrived in Toulouse, goods are unloaded from the trucks as written previously, their physical and administrative reception through the SAP system are then performed. The service provider A must maintain their inventory level at the right level and is in charge, after a replenishment order

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\[100\] *Cahier des Charges Fonctionnel – Plateforme Logistique de Distribution de Saint-Nazaire, Meaulte, Nantes et Toulouse. Airbus France. April 2007*
receipt, of preparing, packaging and distributing fasteners at their respective Kanban modules. The transport between the storing area and the factory is also under its responsibility. One of their employees is based at Saint Eloi and performs the administrative tasks related to the goods reception at the production area and then dispatches them to the points of consumption through a milk run\textsuperscript{101}.

Airbus imposes to the service provider a minimum service level of 94\%, this parameter being the number of effective deliveries to the points of use compared to the number of deliveries required. The performance is evaluated through this criterion but also through audits checking if the operations are performed following the technical specifications initially imposed\textsuperscript{102}. A continuous improvement of the logistics processes is furthermore wished by the customer in order to maintain the partnership.

### 5.5.2 Hamburg

This case is a new example of the problems caused by the decentralisation of the logistics operations management. Hamburg regroups different programs such as the Final Assembly Lines of the A318, A319 and A321, is headquarter of the Centre of Excellence for Cabin & Cargo Customization and is part of the Centre of Excellence for Forward and Aft Fuselage (FAF). As FALs and the different Centre of Excellence manage their own budget and their own logistics operations, they can outsource their activities to different service providers. Thus depending on the manufacturing program, there is a different provider insuring the physical logistics activity at the Hamburg production sites. For the reader information, Hamburg site is divided into different Halles, each one sheltering the manufacturing operations of a program.

The MWZ is the Airbus central warehouse for the whole North Germany. It is located close to Hamburg but covers also the storage of goods for the Bremen, Nordenham, Varel and Stade sites. Contrary to Saint Eloi, this warehouse stores all


\textsuperscript{102} Ibid.
the different commodities including fasteners and has the particularity to be highly automated. It is managed by a service provider, which will be called S, that covers the unloading, administrative and physical reception, storing, handling, picking, preparing, packaging and distributing operations. S has furthermore introduced its own Information System for managing the MWZ, involving the setting up of links between this system and the Airbus’ one. However ordering, forecasting and dimensioning the Freestock unit quantities are under the Airbus responsibility. Moreover S is also in charge of the physical logistics operations for one Halle where it has to deliver the goods until their concerned Freestock modules. These tasks are performed by three different service providers M, O and C and also Airbus at the other Halles.

As written in the part 5.2.2, there is an intermediate storing location or dispatch centre between the MWZ and each Halle. Transport between this area and the reception side of each manufacturing centre is covered by another company. Thus the service provider S, in charge of the MWZ, delivers there goods which will pass under the responsibility of another provider but brings the rest to the Halle under its responsibility. The existence of this intermediate warehouse involves another unloading-reception-loading cycle and then more transactions through the SAP system performed also at every transfer of responsibility which implies additional costs. The simplified figure below tries to summarize the situation. Each coloured point represents a different service provider covering the concerned task.
Airbus pays its partners counting the number of movements (notion defined p.41) performed by the service providers. This can be the number of movement received at the central warehouse, the number of movements ordered at the point of consumptions, etc. Each movement associated to a particular task such as picking or warehousing is characterized by a price. As an example a price listing of the service provider S has been attached appendix 3. The prices have been erased but it still shows the different operations performed and priced. Service level imposed by Airbus Germany at all its providers has to be minimum 95%. Their evaluation process is similar to the one performed in Airbus France described within the previous part.
Chapter 5 - Description of the current situation
6. ANALYSIS OF THE AIRBUS FASTENERS’ SUPPLY CHAIN

This chapter aims at analysing the current situation described all along the previous part. It will consist first of all in applying the theory concerning the classifications of goods and the suppliers’ relationship in order to define requirements for the fastener’s supply chain. Furthermore, a more precise analysis of the Kanban/Freestock quantities will be lead associated to a study of possible delivery means at points of consumption. As a conclusion, solutions of implementing a VMI process will be explored.

6.1 Characterization of the commodity

In order to analyse the fasteners commodity, theory concerning the characterization of a class of components is applied in this part. The ABC-classification based on quantitative factors and the Kraljic model involving qualitative parameters will be performed on our scope.

6.1.1 ABC-classification

A classification related to the ABC method based on volume value and demand enables a determination of the type of components the fasteners are and what range they cover within the Airbus supply chain. As expected, fasteners are mainly classified as C-components as shown in figure 6.1 for the Saint Eloi’s case even though some have a high volume value and therefore stand within the A or B-categories. Categories’ limits used for performing this classification are the ordinary 10%-30%-60%.

Despite the high quantity consumed at the work stations, fasteners are still C-articles because of their low value compared to the other parts used in the aerospace industry. And low classified items must be, following the theory, governed by simple ordering principles and handling techniques maintaining a proper service level at a minimum
cost. Thus looking at the Airbus fasteners’ supply chain, no real strategy has ever been set up for low category parts and savings should therefore be done concerning the logistics costs if concentrating on it. There are many parts of the process that might be improved in order to get a better integration and efficiency from the inventory to the points of consumption.

As written previously, the whole commodity is not classified in the C-category, involving a large range of volume values within the parts. Thus less than 0.2% of the fasteners are within the class A and they are about 2.6% classified as B-items. However all the goods consumed under the Kanban or Freestock processes are ranged within the category C and will be treated consequently.

6.1.2 The Kraljic model

In order to apply an optimal management strategy to our commodity, fasteners are also classified according to the Kraljic’s matrix defining a group of goods by considering the management of their purchasing processes and their strategic importance. Items strictly managed under Kanban or Freestock will be considered all along this analysis.
Airbus’ fasteners commodity presents low risks of supply since it is mainly constituted of standard products provided by many suppliers competing on this segment. Despite the certifications required for supplying fasteners for the aerospace industry, risks in the management of the purchasing processes are pretty low. Furthermore this type of goods does not have any real strong economic influence on Airbus processes mainly because of its low volume values consumed as shown on the ABC analysis. Thus any price variation of those products would not influence the firm’s total costs. The main strategic risks linked to this commodity would be a breakdown in the manufacturing processes caused by an eventual lack of items. Such event could result in delays in the delivery of assemblies to the next production steps, high costs due to late delivery fees and a loose in the firm’s credibility as regard to customers.

After such analysis, fasteners components can be considered as **non-critical items** since the difficulties in managing the purchasing processes and their strategic importance are low. According to the Kraljic’s matrix, the company must concentrate its policy on minimizing costs associated to the handling of fasteners, streamlining the processes linked to the ordering management, the transactions handling and the different administrative costs should be rationalized and integrated. Moreover outsourcing the purchasing activity to a third party logistics could be also a low costs solution according to the theory. The figure 6.2 presents the situation of fasteners on the Kraljic’s matrix.

![Figure 6.2 – Fasteners characterization on the Kraljic’s matrix](image)
6.2 Customer/Supplier relationship

As written previously, nowadays Airbus is working with more than 150 suppliers for providing its four entities, 59 are supplying Saint Eloi and 82 are providing Hamburg in fasteners. They are all working in a more or less close collaboration with their client depending on the frequency they are supplying Airbus sites with. Thus any long-term strategy has never been set up concerning the supplier relationship Airbus want to orient its policy towards. There are hence possibilities of improvement as to the number of suppliers and the development of stable relationships. In order to determine the new supply chain solution for the fasteners, a clear understanding of which kind of relation Airbus should define with its suppliers is required.

Starting any sort of VMI collaboration requires that the client trusts in its partners and therefore increases the position of dependency vis-à-vis its suppliers. However this dependency can be reduced by a high degree of standardization by setting up fixed parameters in order to control the partnership. Afterwards this standardization should be slowly released in order to introduce trustiness in the relationship. Minimizing the influence of these control parameters increases the dependency of the client on its supplier’s performances and choices, which should be avoided for fasteners. As written previously, goods in question are standard items distributed by many suppliers competing on this market segment. Thus costs required for changing supplier should be reduced through a not too high degree of collaboration in order to be always able to get the advantage of the large market competition offered by the fasteners segment.

6.2.1 Bensaous’ model

Fasteners have been previously classified as C-items and non-critical items. Using this classification, the type of suitable relationship with a supplier of fasteners can then be analyzed through the Bensaou’s matrix defined in the part 3.2.3. According to the above arguments Airbus should avoid any investment in the relationship with its suppliers in order to minimize its position of dependency and the costs of an eventual change of provider. The best strategy for limiting Airbus’ dependency on its suppliers
is to keep on issuing goods within its own information system even if the inventory is under the physical responsibility of suppliers. Thus the company still owns data that could eventually be compared and confronted to the one provided. Moreover any investment on specific equipment improving suppliers’ performances should be avoided as much as possible. It might seem at a first look that the collaboration between Airbus and its suppliers aims at minimizing expenses related to the purchase of goods. This is why and despite the previous arguments some investments and certain integration are required in order to make the partnership more effective. On the supplier’s side investments into the relationship will not be that wide since the solution and the facilities are already at their disposal. The relationship between Airbus and its fasteners suppliers can therefore be defined as market exchange on the Bensaou’s matrix but situated close to the buyer captive situation.

Nevertheless Airbus must be careful on the degree of investment required in the partnership so that it does not become dependent on its suppliers. But this issue should remain easy to handle since there are many suppliers that could eventually replace one that did not satisfy Airbus.
6.2.2 Number of suppliers

A large range of suppliers are delivering different types of fasteners to Hamburg and Saint Eloi and even sometimes same PN are provided by different companies. However in a firm trying to define and implement an optimal purchasing strategy, working with so many suppliers constitutes an obstacle to these objectives. Thus on a long-term view Airbus should collaborate with few suppliers and according to the Power project, an objective of four suppliers have been settled for the whole company.

Being provided by as few suppliers as possible considerably decreases the amount of administrative tasks. As written previously many identical PN are delivered by different suppliers and as an example they are 30% of all the fasteners PN to be provided by more than one company. The graph below proves than some class of goods can even be supplied by twelve different providers.

![Number of Supplier for a Reference](image)

Figure 6.4 – Proportion of PN provided by more than one supplier in Hamburg in 2006

Thus complexity is widely increased resulting in unnecessary complex information flows and the absence of a defined purchasing strategy, which could be eliminated by a relevant reduction of the number of suppliers. Decreasing the complexity of
relations even decreases the costs of those relations. By reducing the number of suppliers to four, Airbus would order higher volumes to them and would therefore be in a more advantageous position for any eventual negotiations. This could lead to a more beneficial agreement for the customer and the possibility of coordinating more easily replenishment processes that were getting pretty complicated with 82 suppliers for the Hamburg case.

However the reader should be aware that risks increase with the reduction of the number of suppliers for one commodity. This is the reason why Airbus did not decide to limit its strategy to a single sourcing strategy but chose to keep four suppliers. Indeed according to the theory and the previous classifications, the preferred sourcing strategy is suitable for this commodity since fasteners have a low strategic importance for Airbus and suppliers with high performances in term of schedule adherence and quality are not that many.

The figure above is a selection of nineteen suppliers coupled to their schedule adherence performances during February 2007. It shows that the ability to deliver an

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103 BW extraction. February 2007
order at the required time largely varies from one supplier to the other. Furthermore all along 2007 37% of the suppliers were under 75% of On-Time-Deliveries. A similar analysis of the quality performances can be performed but deliveries are usually for most of them in accordance with the quality requirements imposed by the customer. Thus limiting risks of the defined strategy involves a selection of the suppliers having the best performances so that deliveries bring satisfaction to Airbus. Therefore delivery dependability and OTD parameters of the future selected suppliers must be as close as possible to 100% since such requirement is a selection criteria and a condition for being competitive. Furthermore dealing with four suppliers, instead of a single one in the case of the single sourcing strategy, maintains competition between them and lower prices hence reduces Airbus dependency on its partners.

6.3 Vendor Managed Inventory

As our project has been focusing on the reduction of costs and the implementation of simpler ordering principles, the VMI model presents many answers to the requirements Airbus imposed for defining an optimal supply chain. According to the definition, a VMI system is a collaboration between a company and its suppliers in order to optimize the supply chain efficiency regarding the availability of goods and to minimize costs by eliminating unnecessary activities. Supplier is then responsible of replenishing and maintaining the level at a level mutually agreed with its customer.

In order to apply the right form of VMI in accordance with the above arguments and the Airbus criteria, the solution has been placed on the figure previously presented in the part 3.3. Airbus should release its entire fastener’s inventory under the VMI under consignment method as shown in the figure below.
Fasteners have been classified as C-item and thus savings must be performed on the handling processes while keeping high service level. By letting to the supplier the access to the inventory data and the responsibility for maintaining the inventory level required, supply chain performances might be highly improved above all because the stock would also remain under the supplier's property. Hence the supplier would manage the inventory at customer's sites and decide on replenishment policies, subject to stipulated levels of availability and service agreed in conjunction with the customer.

Concretely Airbus must provide historical demand and forecast data, production plans and inventory tracking so that its selected suppliers can determine a replenishment strategy, maintain the inventory level and then meet the customer service level requirements. Inventory should be managed close to the production area within Airbus facilities such as the fasteners warehouse for the Toulouse area or the central warehouse in Hamburg. Thus purchase orders are no longer raised by Airbus but the supplier is responsible for managing their production planning. Furthermore a min and a max level are determined for each reference, on the agreement of both sides, so that risks of overstock or shortage are limited.

On a physical operations point of view, the number of inventory locations will be reduced with the introduction of VMI as shown by the figure below. Problems of dependency on its suppliers have been described at the beginning of the part 6.2 and
have to be considered. As all the stock property will be released under the providers’ responsibility, Airbus must electronically manage inventory in order to keep traceability of the stored goods. Thus each and every stock movement will be processed against the supplier’s lot numbers which will be recorded and posted in a hub where all information coming from Airbus and its providers will be shared.

Therefore such implementation provides improvements and cost savings for both parties. Inventory levels are highly decreased and in an optimal case there are only WIP stocks within the customer facilities since the rest is still under the supplier’s responsibility. Both parties are interested in providing a better service to the end customer. Having the correct item in stock when the end customer needs it, benefits all parties involved. Results have shown that suppliers who have an OTD performance of 90% generally have a service level of 99.5% or more. Moreover Airbus would not only release its fasteners stocks but also the forecasting, planning ordering and physical logistics operations that would be performed by the supplier.

The introduction of the VMI process onto the Airbus supply chain can therefore eliminate the non-value adding activities between the Saint-Nazaire and Saint Eloi. Indeed fasteners will not be delivered anymore to the Saint-Nazaire facilities for being then sent to Toulouse but these goods will be directly sent and managed in the fasteners’ warehouse covering the Toulouse area. Such transfer will vanish from the current logistics processes since PN are managed under the VMI system and suppliers do not have any need of using the Saint-Nazaire facilities. Tasks such as unloading,
loading, packing, handling or physical and administrative receptions previously occurring all along the Saint-Nazaire Toulouse transfer will hence be eliminated.

This solution introduces also a new selection criterion for the project concerning the reduction of the number of suppliers. The four selected providers that will take over the fasteners supply will present the best performances regarding quality and schedule adherence and relevant abilities to insure the implementation of the VMI. They will not be evaluated anymore by looking at the R₁ and D₁ parameters (see part 5.4) but by considering their service level presenting the average number of days while inventory levels are in-between the min and max levels over a given period. But working with four suppliers in a VMI configuration might also pose many problems starting by deciding which one will manage the global fasteners’ inventory. Thus the one selected could benefit from an advantageous position compared to the others and this is truly impossible. Nevertheless an alternative solution could consist in contracting another actor which would be responsible of the physical logistics operation.

6.4 Physical logistics strategy

As explained previously, implementing the VMI process using four suppliers might cause some problems for Airbus to keep a neutral position vis-à-vis them. Furthermore the company has already started to develop an outsourcing strategy for the physical logistics as described through the examples of the MWZ in Hamburg and the fasteners’ warehouse in Toulouse. And this strategy should be kept and added to the VMI solutions in order to place between Airbus and its suppliers a neutral actor. Whether within the MWZ or the Toulouse fastener’s warehouse, a VMI system will be implemented so that goods property is transferred under the suppliers’ responsibility that will furthermore maintain inventory levels between the min and max levels agreed with their customer. But all the physical logistics side of the activity will be covered by a service provider in charge of handling, preparing and distributing the goods to the points of consumption. It will also be in charge of determining the Kanban or Freestock quantities they have to deliver to the work stations. Thus VMI increases the inventory turnovers, reduces the stock levels and the holding costs on
the Airbus side, and combined with a physical logistics outsourced to service providers it maintains competition between the four suppliers. Information and material flows under this configuration are presented on the figure below, the customer platform and the distribution being handled by the lead service provider.

Figure 6.9 – Physical logistics organization

The physical logistics is not considered as a core competency in Airbus and is potentially outsourceable but it still plays a strategic role within the whole organization. Indeed companies are competing through their supply chain efficiency and must integrate it as much as possible in order to limit costs generated by this activity. Furthermore this new type of competition involved the development of a new sort of service delivered by a third party logistics which enables companies to outsource at a high level their logistics activities. To obtain the most integrated and efficient supply chain, information and data must be shared between the different actors involving mutual trust and exchange of knowledge. The most suitable strategy is therefore the **single sourcing** solution for which a third party logistics company could take over the whole physical logistics activity. As many companies are competing on such market segment, performances through their efficiency and the low costs solutions applied must be optimal. Usually the chosen logistics providers may invest in dedicated facilities and even in personnel training which makes their service tailored to the customer’s requirements. Such relationship is hence a supplier
Captive situation where the service provider is constantly under a risk of switching in case of unsatisfactory performances.

The previous chapter has also shown problems generated by sharing activities between many service providers. Hamburg is the perfect illustration. The MWZ, the transport between the intermediate storage point and the different Halles and the distribution within those Halles are all managed by different actors, making logistics costs incredibly high. As a matter of fact, there are break bulks caused by the intermediate warehouse and others at each Halle where a different service provider is in charge of the distribution. At every break bulk, none adding value tasks like unloading and loading trucks, administrative and physical receptions (see appendix 3 listing all the activities performed by a service provider) are performed increasing costs and could be avoided with a more integrated organization. Moreover, the intermediate storage point existence is only due to the transfer of responsibilities from one service provider to the other occurring before the delivery to the Halles. This dispatching zone could indeed be eliminated by outsourcing the logistics activity of the whole Hamburg site and the MWZ to one single provider. At a global scale and based on the same analysis, relevant savings could be performed by outsourcing the physical logistics to a European lead service provider and hence it confirms the previous arguments orienting the sourcing strategy to a single sourcing solution.

The last assertion did not only deal with fasteners but with all the commodities. The lead service provider should take over the logistics operations for all commodities in order to rationalize the areas where these operations are separated by type of goods. Thus Toulouse fastener’s warehouse would be integrated to a global warehouse managing the whole supply activity to the production sites leading to savings through reduction of facilities, equipments and work forces. Details of the logistics operations performed leading to more efficient material and administrative flows will be described in the part 6.6. This collaboration also requires a complete share of information between both parties so that the provider performs its tasks in a proper way and Airbus keeps traceability and control on inventories for planning its
production. The lead service provider should either use its own information system, requiring then a hub enabling data transfer between both parties, or Airbus’ one which might be less competitive.

Such rationalization also requires changes in the logistics management. Logistics operations have always been placed under the responsibility of each Centre of Excellence or FAL involving differences in the strategies, in the service providers or the suppliers contracted. A new centralized organization should be set up imposing a global logistics strategy to the whole company, allocating budgets, and managing the operations through different regional logistics centres (see figure 6.10 below and the appendix 4) under its control.

But above all outsourcing the physical logistics to a European lead service provider cannot be realised without such organization. These regional centres would insure storage, inventory management and distribution under the service provider’s responsibility coupled with a logistics management branch governed by Airbus. This is the most optimal solution mainly because commonalities of goods PN between each production sites are low (see appendix 5) and any global solution would therefore be worthless. Indeed a solution adopting an international hub for a global integration
may be inefficient since specificities of each site would constitute a strong obstacle to the eventual advantages brought by this total rationalization.

6.5 Inventory policy

Kanban and Freestock quantities are calculated on a base of a one-month duration for each box. In order to maintain such limit, quantities calculation should be performed frequently so that stock levels are kept at a proper level. Even though this policy aims at minimizing stocks level and cash holding in the inventory, keeping those quantities continuously updated remains difficult because of the incredibly high amount of PN. Thus logistics managers often notice a too high level of stock by only checking one PN after the other. As a matter of facts fasteners managed under the Kanban or Freestock systems are currently over stored in Saint Eloi or Hamburg production areas. Such inventory levels are probably due to a non proper traceability or a too scarce data updates. And as a consequence fasteners’ WIP stocks are freezing a high amount of cash despite their low value.

Figure 6.11 – Number of bins and their duration in Hamburg
Chapter 6 - Analysis of the Airbus fasteners’ supply chain

The graph above proves that about 90% of the bins managed under the Freestock process are dimensioned for more than one month duration. And even 35% of them constitute a stock stored for more than one year. The appendix 6 shows also that many PN consumed in high quantities are only dispatched few times a year and it therefore contributes to these high levels of inventory. In an extreme situation, some parts have been detected with a sixty months stock under the Airbus facilities. In addition to the problem of holding cash, storing goods for such a long time increases risks of obsolescence and deterioration of the items.

Indeed the box size determination should take into account costs generated by all the transversal logistics tasks associated to the storage. By minimizing the WIP stock within the production area, logistics and holding costs must be balanced in order to find the optimal quantity contributing to the lowest total cost. But first of all items scarcely consumed should not be managed anymore under the Freestock or Kanban process. They constitute unnecessary stock and their handling operations would be more efficient and cheaper under a SWC flow since this would eliminate preparation costs. Hence if articles consumed less than ten times a month are considered as slow movers and moved from a SWK to a SWC flow, this strategy would provoke a WIP reduction of 12% and a costs reduction associated to. The other part conserved under the Kanban and Freestock systems must then submit optimizations in its quantities calculation.

As described in the appendix 3, the fasteners’ supply chain from their delivery to the warehouse to their consumption generates multiple costs which were presented in the part 3.4.2. The following analysis will be based on the Hamburg data but could be performed in the same way on Saint Eloi samples leading to the same conclusions. By calculating the optimal replenishment frequency of the global stock, each box size is

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104 Hamburg data
105 Ibid.
106 Ibid.
also determined and costs of all the process are then minimized. According to the figure 5.5, the zipping, picking, preparing, uploading, unloading and distributing operations are source of logistics costs increasing with the number of movements while holding costs are varying in the opposite way. Thus the annual total cost of the process is characterized below in a simplified formula, X being the yearly number of replenishment, Y the number of bins processes, \( V'V \) the annual volume value of the fasteners’ stock based on the consumption, V_{Bin} the physical volume of a standard Freestock bin and H the holding costs rate considered as 0,3% of the volume value\(^{107}\).

\[
TC = Y.X.\varepsilon_{zip} + Y.X.\varepsilon_{pick} + Y.X.\varepsilon_{prep} + Y.X.\varepsilon_{pack} + Y.X.\varepsilon_{Dist} + Y.X.V_{Bin}.(\varepsilon_{up} + \varepsilon_{un} + \varepsilon_{Trans}) + H.V./X
\]

The service providers charge Airbus regarding the number of bins processed for the zipping, picking, preparing, packaging and distributing tasks while the transport operations prices are calculated in term of volumes moved. The first line of this formula represents the logistics costs while the second exposes the average holding costs of a bin. Therefore the optimal replenishment frequency is calculated, similarly to the Wilson formula, after having derived the previous numerical expression and made it equal to zero. Once the optimal replenishment frequency calculated, the quantity contained in each Freestock box will be also determined and the costs generated by the replenishment process will be minimized. Thus and as indicated on the figure 6.12, the optimal turnover of the fasteners stock managed under Freestock would be \textbf{twice a month}. This analysis concerns only the WIP stocks and in any case the inventory stored within the central warehouses. In term of savings, applying such formula makes relevant cash savings due to the WIP reduction but it also has an EBIT impact. The holding costs are indeed lower because there are fewer parts to manage and despite the increase in the logistics costs because of the higher movement frequency, Airbus still performs savings in this case. The figure 6.12 displays the different costs involved and the optimal situation compared to the one month

\footnote{Parameter fixed for the project Power\(^8\)}
Freestock size scenario. Such method does not define the definitive sizes that will be set up but rather dimensions the real improvements that can be performed in the calculation of the Kanban and Freestock sizes. Nevertheless this WIP reduction is a first step on the way of a leaner and more cost effective supply chain. Forecasts are still based on the consumption and are therefore remaining approximate. Other measures leading to better results can be taken once the company will have invested into tools or processes enabling more accurate forecasts but also delivery means more suitable to the production cadences.

6.6 Material flows and delivery means

The part 6.4 has already demonstrated that outsourcing the physical logistics to a single service provider leads to consequent improvements in term of material flows. Most of the break bulks previously occurring would disappear. Thus there will not be any use for an intermediate storage point in Hamburg or a parasitical flow between Saint Nazaire and Toulouse.

Delivery means used to make the fasteners available to the workers are also influencing the efficiency of the material flows. As an example a worker looses 15%.

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108 Eduardo Dominguez Puerta. AIRBUS SAS. 10/01/2008
of his time in performing logistics tasks that would not be necessary if the manner of making parts available were optimized. Moving from the work station to the Kanban or Freestock modules for simply picking fasteners is time costly and could be avoided with better delivery means. A first solution which might be developed and that has been observed in Airbus UK during this project is the utilization of assembly kits. Instead of delivering fasteners to the modules, the service provider brings directly a suitcase to the work station. Such suitcase contains all the fasteners required for performing the operations at the concerned station with quantities determined following the previous method. Once an assembly kit empty, it is stored in a special area and the service provider is in charge of its replenishment. There is furthermore a buffer zone similar to the reserve side of the Kanban and Freestock boxes, where full assembly kits are available.

Workers do not need to move to the modules anymore and time spent on non-value adding tasks is saved. Consequently the company does not only increase its efficiency but can also decrease its work force. There is no change concerning the service costs since the service provider prepares those assembly kits at the central warehouse instead of the Kanban or Freestock boxes and delivers it to the work stations instead of the modules. For instance such assembly kits contain a two weeks stock of
fasteners consumed at the concerned work station for one sort of MSN\textsuperscript{109} (Material Serial Number). The second advantage of implementing this new delivery process remains in the elimination of the over consumption usually due to parts which are at the free disposal of workers. In our case workers receive their parts at their working area with a defined quantity so that they can not consume more than they need.

Implementing this new system involves the creation of a flow of empty assembly kits sent back to the central warehouses for a new replenishment. However it will not create any new expenses since the service provider can use the truck delivering goods to the factories for bringing back empty assembly kits. And it also generates savings by working with re-usable packages instead of plastics bags that are emptied in the Kanban or Freestock bins.

Then WIP reductions might be performed by optimizing continuously the quantities made available within those assembly kits. Obviously the best opportunity to forecast the amount of fasteners required to perform an assembly operation would be a perfect definition of the BOM. This point has been treated in the part 5.3.1. Nevertheless because of the constant changes of fasteners dimensions made at the work stations level, this tool can not be updated in a proper way. Insuring a strict follow-up of the constant changes and maintaining the BOM up-to-date appears at the moment more expensive than basing forecasts on past consumption. With a correct BOM, forecasts would not be based anymore on consumption but on the orders. Fasteners could be furthermore available on “panoplies” containing the exact amount necessary for performing an operation. A panoply would then contain the exact number of fasteners associated to one specific operation of a MSN. Suppliers would be in charge of delivering their products already packaged in those panoplies, while still maintaining inventories level between the min and max limits defined within the VMI agreement. Hence the lead service provider would not be responsible anymore of the preparation but only of the handling, storing and distribution tasks, generating

\textsuperscript{109} A MSN is a code associated to a final aircraft
therefore new savings. And those panoplies would be available through the MSU presented part 5.2.2. This scenario has already been tested in Broughton (Airbus UK) for detailed parts for which quantities are easily forecasted using the BOM because no changes are occurring at the production level. Results have been successful and savings in packaging, WIP stock, production time were performed.

Traceability also improves the efficiency of material and administrative flows. The RFID technology getting more and more accessible at low costs, it would be interesting to implement it on the fasteners supply chain. Joining a RFID tag to every assembly kits or panoplies, in a more optimized scenario, would eliminate every single administrative reception and insure a strong traceability of the goods stored as WIP in the production area. Once a RFID reader installed in the reception area, every single new arrival would be detected and registered within the ERP, and the empty assembly kits flow would also be traced.

Airbus can thereby get rid of the preparation and reception tasks and avoids a waste of production time by making available fasteners at the work stations.

6.7 Plan For Every Parts (PFEP)

Once the physical logistics outsourced and the inventories transferred under the supplier’s responsibility, Airbus does not perform anymore the logistics activities but become a coordinator. Therefore the company needs to equip itself with tools displaying proper information to the supply chain actors so that a strict follow-up can be performed with relevant decisions and implementations. At the moment, the only tool displaying information is SAP. However accesses to this database are restricted depending on the origin of the request. As an example a purchasing agent will not have access to the manufacturing information and a production manager will not know anything about procurement data such as suppliers’ performances or lead times. However they could constitute relevant information for assisting him in planning the production. Yet a supply chain becomes more effective once every part is integrated
into a global model and an actor is able to make a proper decision only if he knows all the levers at stake.

Our project aims to standardise logistics solutions from the suppliers to the consumer, extending JIT approaches and providing visibility from suppliers to point of use. In parallel Lean Manufacturing principles are being deployed under ALPS (Airbus Lean Production System) organisation responsibility. ALPS needs a Supply Chain & Logistics support to achieve transformation by adapting supply process to the target manufacturing one, managing interface with Suppliers and Logistics Service Providers. Thus a tool, called PFEP, must link the different services for a better integration and has been under development all along this project. PFEP is a Supply Chain related information sharing tool that enables Supply Chain Integration from Manufacturing to Procurement. This is not another operation system or a reporting tool even though it must automatically extracts data from corporate tools and incorporates valuable information not available in the ERP. As written previously it aims at sharing information to the relevant Supply Chain actors involved in the process: Manufacturing, Logistics & Ordering, and Service Providers so that they can make the right decision. Its objectives are therefore as following:

1. To bring a support to the identification of optimized logistics flows, in line with the ordering solutions
2. To capture the customers requests regarding distribution means and processes (Packaging, Frequency, Quantities, Delivery Address, in line with Standards)
3. To monitor and plan the logistics processes
4. To support the lean logistics deployment in line with ALPS

PFEP must allow a different view of part parameters for every Supply Chain actor. A decision support tool for the optimal logistics flows should be incorporated. It furthermore displays data concerning the standard delivery solutions linked to a manufacturing unit, station, shift and the Service Level Agreement (SLA) for each delivery. Concretely the PFEP displays a complete ID of each part processed in terms
of procurement/ordering, logistics and manufacturing information. Thus such tool is a workplace to share information where different views and roles must be allowed. Within Airbus, each area has visibility on any relevant information concerning the product and is responsible for the data reliability and update of the information existing in its section. External actors have access to information relevant to their activity. The main information blocks will be as follow:

Consequently PFEP must be divided into four blocks, each one concerning data related to its customer.

**The customer block**
This information block is mainly dedicated to Manufacturing. The responsibility of data is under a Lean Manufacturing specialist. This part presents parameters such as the PN code, the delivery point, the program, etc. All the data available within this block are presented in appendix 6.

**The supplier-product block**
This information block is mainly dedicated to Procurement. The responsibility of data is under the responsibility of a Lean Supply Chain and Logistics specialist. It displays information like the supplier, the vendor code or the lead time.
The supply chain operations-logistics block

This information block is mainly dedicated to Supply Chain and Logistics. The responsibility of data is under the Supply Chain Operation Organizations. Here there are three sub parts describing different steps of the supply chain.

1. Standard flows. This block will provide guidance on the Logistics Flow decision through a decision support tool. It is based on the current Airbus standard flows: SC, SWC, SK, and SWK. This decision support tool takes into account product / commodity characteristics and constraints to recommend the possible flows. It also provides priorities to implement, based on the benefits that could be provided. The decision support tool provides guidance, but the logistician will always take its final decision on the reviewed flow that will be updated in the Supply Chain Operations – Logistics.

2. Warehousing. This block will gather information relevant for warehousing such as the volume and weight of delivered items, type of package, storing mean, etc.

3. Standard Delivery Solution. This block will gather information relevant for the distribution to the point of use in order to define the Service Level Agreements with the consumer. Data like the delivery mean, the distribution packaging, service provider, etc are displayed within this part.

The Supply Chain Operations – Ordering block

This information block focuses on ordering parameters and therefore the content is under the ordering optimisation programme responsibility. Nevertheless it might share information such as the re-ordering point, the min and max levels, the safety stock, etc.

All these information provided within the same tool must be continuously kept updated by downloading them from the ERP. And any change occurring within this system must also be uploaded back to the ERP. Thus this is by sharing all these data that real optimization can be performed. As an example a real improvement in the packaging strategy can be done when knowing the type of conditioning coming from the supplier and the one used for distributing goods to the points of use. Looking at
those data, a standardization concerning this issue can be proposed in order to limit the number of tasks performed between the delivery to the warehouse and the distribution to the production area. This is how solutions like panoplies opportunity came up and will therefore be developed. The implementation of such system involves some investments coming from the IT department and it furthermore requires PFEP controllers to update, launch processes, and control the flows within this common repository.

Moreover the PFEP must monitor and plan logistics processes (see p.80) helping in implementing decisions which came up through it\textsuperscript{110}. Several functionalities can therefore be embedded in this tool, properly described as followed.

- In case of an engineering change, the PFEP controller can make a proposal of a new embodiment date. If accepted changing the data in the PFEP will change the similar data in the SAP. Then the process includes a way to get rid of the unused stock at a minimal cost: return to the supplier in order to modify the parts, transformation into spare parts, giving it to the training school or scrapping it as a last solution.

- Change in the location of parts

- Change in the inventory policy (concerns mainly the ordering part through re-order point, batch sizes, safety levels, etc)

- Standard Labeling including Min Max Policy & Lineside delivery addresses

As a conclusion PFEP is a decision support tool sharing all the data required for a better understanding of the whole process and furthermore assists a manager in setting up new solutions. PFEP must be sustained by a strong IT support enabling competitive transfers with the SAP system and automatic changes of the database implemented through bar codes or even RFID technology. It constitutes a great opportunity to reach objectives fixed by the project.

\textsuperscript{110} Mike Lacey. AIRBUS UK. 04/12/2007
Chapter 6 - Analysis of the Airbus fasteners' supply chain
7. CONCLUSIONS & RECOMMENDATIONS

In this chapter, conclusions regarding the previous analysis are presented and compared to the objectives initially set up. Furthermore recommendations for reaching a more effective supply chain are proposed with the measures required for changing processes and organization so that transformation becomes possible.

As described at the beginning of this Master Thesis, the project aimed at mapping the fasteners’ logistics practices strictly focusing on the Kanban and Freestock processes. Based on this analysis, zones of improvements have been highlighted where great changes would bring savings and build a more effective and integrated supply chain. However implementing a new logistics policy might not only require important changes in the organization of Airbus but also a new way of thinking as a global and single company.

7.1 Zones of Improvements

At the time the study began, many improper operations through the way of managing the fastener’s logistics were noticed, constituting obstacles to the Power objectives. In addition to the differences in this domain between Saint Eloi and Hamburg practices, limiting the integration of Airbus as a single company, many non value adding activities and worthless operations were performed all along the processes.

Fasteners were not treated as a low value commodity with a limited strategic importance, making the operative costs relatively high. Even though systems such as Kanban or Freestock with their associated infrastructures were already set up, inventory levels remained incredibly high. In Hamburg, few parts could reach a twelve months inventory level! Improvements of the WIP inventory management including forecasting and ordering operations were therefore necessary.
Chapter 7 - Conclusions

The sourcing strategy was not rationalized and as a consequence there were no strong limitations in the purchasing policy. Thus Airbus was provided in fasteners by more than 150 suppliers involving the supply of identical parts by many different suppliers.

Despite the outsourcing of the physical logistics, enabling the company to concentrate on its core activities, the decentralisation of the logistics operations had created many break bulks all along the material and administrative flows. Indeed several service providers were contracted involving many transfers of responsibilities and costly non value adding tasks.

Finally the material flows and the production showed some disturbances due to unsuitable delivery means and improper traceability.

7.2 Results and proposals

Fasteners were classified as C-items, following the ABC analysis based on volume value, and non-critical items in accordance to the Kraljic model. Therefore the study focused on minimizing handling costs in the inventory operations and delivery to the points of consumptions. Objectives were to enable fasteners to be delivered in suitable quantities and at the right time to the work stations.

Furthermore due to the fasteners’ segment market and the large number of suppliers able to provide Airbus, costs required for changing supplier should be reduced through a not too high degree of collaboration. Relationship between the company and its suppliers is therefore defined as market exchange. This means that investments into the collaboration must be limited in order to avoid any problem of dependency. Nevertheless Airbus was working with a too high quantity of suppliers, and project oriented the sourcing strategy towards the selection of four lead suppliers. Thus purchasing operations are simplified and relationships between both parties are closer enabling a better integration. However Airbus maintains competition between those four partners and does not exposed itself to risks provoked by a single sourcing configuration.
Chapter 7 - Conclusions

The best retained solution for decreasing inventory levels and costs related to this activity is the VMI under consignment. The company will transfer the stocks property to its supplier with all the operations associated. In order to limit the dependency on the provider caused by such solution, Airbus must manage electronically its stocks in order to keep traceability of the stored goods. Implementing this solution will eliminate parasitical flows such as physical transfer of inventory from Saint-Nazaire to Toulouse facilities as presented in the part 6.3. Hence three selection criteria will help to choose the four suppliers contracted. Suppliers with best schedule adherence and quality performances will thus be selected, but they will furthermore have to be able to implement a proper VMI solution fitting with Airbus processes. Moreover Airbus should not only release its fasteners stocks but also the forecasting, planning, ordering and physical activities.

However implementing a VMI system with four suppliers working within the same facility seems impossible and requires outsourcing the physical logistics to a service provider. Furthermore due to the characteristics of this service, Airbus must rely on a single lead service provider. Many break bulks appeared when analyzing the current practices especially in Hamburg and would disappear if implementing this proposal. This European lead service provider will take over the whole physical logistics by managing the different central warehouses and this concerns all the commodities. The fasteners warehouse located in Toulouse would then be integrated in a central warehouse for the whole area. Concerning our scope, the service provider would be in charge of handling, storing, defining Kanban/Freestock sizes and delivering to the points of consumption.

Thus suppliers and the lead service provider must either work with an information system compatible with Airbus’ SAP system or with their customer’s system itself. As written previously and in order to keep its independency, Airbus investments into these collaborations must be as low as possible.

After having balanced logistics costs and holding costs through a Total Costs Analysis, results led to the conclusion that Kanban and Freestock should be sized for two
weeks duration. This change would involve higher replenishment frequencies but would enable the company to free cash previously frozen in stocks holdings and to perform high cost savings. Items with low consumption do not enter in the scope because they should be removed from the Kanban and Freestock systems and be managed under SWC flow. Useless WIP stocks would therefore be eliminated from the production area.

These quantities were previously available in Kanban and Freestock modules located close to the work stations, compelling workers to move to those areas. Through the constant will of eliminating unnecessary tasks, an improvement of the delivery means was studied. Using assembly kits delivered to the work station containing a quantity of fasteners determined previously will indeed eliminate any useless moves of the workers. This will also contribute to limit over consumption and to perform high savings by using re-usable packages.

All those changes should move the supply chain to a more cost effective and competitive model helping Airbus achieve its objectives. Nevertheless releasing all these responsibilities to some external companies involved the creation of a decision support tool called PFEP consisting in making available all information from procurement to manufacturing. Every actor could therefore get access to data that were not accessible in the former system, making decisions more reliable.

7.3 Recommendations and limitations

These proposals must be understood as a long term strategy that can not be applied in a short period of time. Some of them even require changes in organization, large investments and in the approach of thinking the logistics. At the moment parts of the solution described in the previous section are tested as pilots within located stations of the production sites in order to bring results and concrete savings of such implementation.

Thus reduction of the number of suppliers, implementation of the VMI model under consignment can be applied on the future programs still at their premises for which
supply chain is under design. For current programs such as A320 family, the supplier choice will be slowly decreased and parts will be gradually moved from Airbus to concerned suppliers’ property. Concerning the European lead service provider, Airbus logistics management must become centralized so that the provider works under one single authority. However political problems might come up since every program has currently its own logistics department. PFEP might deal with the same kind of issue since it offers the opportunity to release data from different departments into a single database. As an example Procurement will have to justify its choices to the Manufacturing if some of its decisions displayed through PFEP seem confusing for the latter.

Some other proposals must require high investments. Distributing fasteners at the work stations in specific panoplies for one operation of one MSN compels precise forecasts. Forecasting could not be based anymore on past consumption but on a perfectly defined BOM. However as described in part 6.6 and due to the continuous changes at the production level on fasteners fixed onto assembly parts, keep a BOM up-to-date is difficult and requires high investments in personal and tracking tools.

As a conclusion the main obstacle to such improvements relies in the “Airbus way of thinking”. Despite its status of a single company, every entity, UK, Germany, Spain and France, have still strong influences on the global strategies. It is therefore hard to make them think into a single group. Thus many implementations are constantly made at a local level but never brought into a global solution, making the entities working with different processes and on different tools. “Airbus single way-of-working” is more than ever the condition of success in logistics as well as in many other fields of the business before other companies make a step into the closed competition of the aeronautics industry.
Chapter 7 - Conclusions
## Glossary

**BOM** | Bill Of Materials
---|---
**D₁** | Parameter evaluating the schedule adherence performances of a supplier
**EDI** | Electronic Data Interchange
**FAL** | Final Assembly Line
**EBIT** | Earnings Before Interests and Taxes
**EOQ** | Economic Order Quantity
**ERP** | Enterprise Resource Planning
**Fasteners** | Hardware devices that mechanically join or affix two or more objects together
**Freestock** | German system similar to the Kanban
**Kanban** | Signalling system to trigger actions
**Movement** | Associated to the reception of a certain quantity of items at the Point of Use on SAP
**MRP** | Material Requirements Planning
**MSN** | Material Serial Number
**MSU** | Mobile Service Unit
**OTD** | On-Time Delivery
**PFEP** | Plan For Every Part
**PN** | Part Number
**Power8** | Airbus project aiming at implementing a new business model
**Pylon** | Assembly part linking the engine to the wing
**R₁** | Parameter evaluating quality performances of a supplier
**SAP** | Versions of the enterprise resource planning software product of SAP AG
**SC** | Supplier – Consumer logistics flow
**SK** | Supplier – Kanban logistics flow
**SWC** | Supplier – Warehouse – Consumer logistics flow
**SWK** | Supplier – Warehouse – Kanban logistics flow
**TAC** | Total Cost Analysis
**VMI** | Vendor Managed Inventory
**WIP** | Work In Progress
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WO</td>
<td>Work Order</td>
</tr>
<tr>
<td>3PL</td>
<td>Third Party Logistics</td>
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Table of References
APPENDIX 1 – AIRBUS Saint Eloi Kanban modules

location
APPENDIX 2 – Price listing of the different operations performed at MWZ

<table>
<thead>
<tr>
<th>Leistungspaket 2007</th>
<th>Maßeinheit</th>
<th>Preis</th>
</tr>
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<tbody>
<tr>
<td>A Warenausgang</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1 Entladung, Separierung, WE-Kontrolle, WE-Buchung zweistufig für Einlagerung MWZ</td>
<td>WE-Position</td>
<td></td>
</tr>
<tr>
<td>A2 Entladung, WE-Kontrolle, WE-Buchung einstufig</td>
<td>WE-Position</td>
<td></td>
</tr>
<tr>
<td>A3 Verladung im Werk, Entladung, Scannung, Bereitstellung MWZ-intern</td>
<td>Briefmarken-Etikett</td>
<td></td>
</tr>
<tr>
<td>A4 Entladung, Separierung, WE-Kontrolle, WE-Buchung zweistufig nur erste Stufe (MB01) für Cross-Docking</td>
<td>WE-Position</td>
<td></td>
</tr>
<tr>
<td>AB1 WE - Verpackung (&quot;Abtuten&quot; Freestock)</td>
<td>WE-Position</td>
<td></td>
</tr>
<tr>
<td>B Cross Docking zu dezentralen Lägern oder MWZ-intern</td>
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<td></td>
</tr>
<tr>
<td>B1 Transport WE-WA, Verladung, Bereitstellung Work</td>
<td>WE-Position</td>
<td></td>
</tr>
<tr>
<td>B2 Transport zu MWZ-internen Zielen</td>
<td>Briefmarken-Etikett</td>
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<td>C Einlagerung</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1 Einlagerung manuelle Lagerbereiche</td>
<td>WE-Position</td>
<td></td>
</tr>
<tr>
<td>C2 Einlagerung AKL</td>
<td>WE-Position</td>
<td></td>
</tr>
<tr>
<td>C3 Einlagerung Paletteilager</td>
<td>WE-Position</td>
<td></td>
</tr>
<tr>
<td>C4 Einlagerung Kragelager (schwer)</td>
<td>WE-Position</td>
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</tr>
<tr>
<td>C5 Einlagerung Sitzschienen</td>
<td>WE-Position</td>
<td></td>
</tr>
<tr>
<td>C6 Einlagerung Gefahrzub. Palette, GiBo, Fass</td>
<td>WE-Position</td>
<td></td>
</tr>
<tr>
<td>C7 Einlagerung Gefahrzub. manuell</td>
<td>WE-Position</td>
<td></td>
</tr>
<tr>
<td>C8 Einlagerung geb. Rohre</td>
<td>WE-Position</td>
<td></td>
</tr>
<tr>
<td>D Kommissionierung, Auftragszusammenführung,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bereitstellung MWZ-intern</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D1 aus manuellen Lagerbereichen</td>
<td>Auftrags-Pos</td>
<td></td>
</tr>
<tr>
<td>D2 aus AKL</td>
<td>Auftrags-Pos</td>
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</tr>
</tbody>
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## Appendices

### E

<table>
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<th>Code</th>
<th>Description</th>
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<td>aus Palettenlager</td>
<td>Auftrags-Pos</td>
</tr>
<tr>
<td>D4</td>
<td>aus Kragarmlager (schwer)</td>
<td>Auftrags-Pos</td>
</tr>
<tr>
<td>D5</td>
<td>Sitzschienen</td>
<td>Auftrags-Pos</td>
</tr>
<tr>
<td>D6</td>
<td>Gefahrgut Palette, GiBo, Fass</td>
<td>Auftrags-Pos</td>
</tr>
<tr>
<td>D7</td>
<td>Gefahrgut manuell</td>
<td>Auftrags-Pos</td>
</tr>
<tr>
<td>D8</td>
<td>geb. Rohre</td>
<td>Auftrags-Pos</td>
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### Kommissionierung, Auftragszusammenführung, Verladung, Bereitstellung für Werksgelände Finkenwerder

<table>
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<tr>
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<tr>
<td>E2</td>
<td>aus AKL</td>
<td>Auftrags-Pos</td>
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<tr>
<td>E3</td>
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<td>Auftrags-Pos</td>
</tr>
<tr>
<td>E4</td>
<td>aus Kragarmlager (schwer)</td>
<td>Auftrags-Pos</td>
</tr>
<tr>
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<td>Sitzschienen</td>
<td>Auftrags-Pos</td>
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<td>Gefahrgut Palette, GiBo, Fass</td>
<td>Auftrags-Pos</td>
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<tr>
<td>E7</td>
<td>Gefahrgut manuell</td>
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<tr>
<td>E8</td>
<td>geb. Rohre</td>
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### Folio Warehouse

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<td>Auslagerung</td>
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<tr>
<td>F3</td>
<td>Zusatzbedarfe</td>
<td>ZB-Position</td>
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### Sonderprozesse

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<tr>
<td>S1</td>
<td>Eilabwicklung Wareneingang</td>
<td>Eil-Pos</td>
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<td>S2</td>
<td>Abwicklung Freestock-Guler</td>
<td>Butler St.</td>
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<td>S3</td>
<td>KIT Abrechnung ADBA</td>
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### Summe Einzelpreise

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### Overhead

### Zwischensumme

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<tr>
<th>Description</th>
<th>Summe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>
APPENDIX 3 – European integration of the logistics activities
APPENDIX 4 – Commonalities of goods PN between the different Airbus sites

<table>
<thead>
<tr>
<th>Number of entities consuming same PN</th>
<th>Number of PN consumed in x similar entities</th>
<th>Percentage of PN consumed in x similar entities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>17413</td>
<td>79%</td>
</tr>
<tr>
<td>2</td>
<td>3269</td>
<td>15%</td>
</tr>
<tr>
<td>3</td>
<td>953</td>
<td>4%</td>
</tr>
<tr>
<td>4</td>
<td>335</td>
<td>2%</td>
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</table>
APPENDIX 5 – Number of PN yearly dispatched performed and the volume value associated to these movements

10434 PN (74%) ~ 8,3 M Parts stored
APPENDIX 6 – Data available through the PFEP

Customer block

<table>
<thead>
<tr>
<th>Information Field</th>
<th>Definition</th>
<th>Information Available (Y/N)</th>
<th>System</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component</td>
<td>PN code to be analyzed</td>
<td>Y</td>
<td>LOCAL SAP/ARP</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>PN description</td>
<td>Y</td>
<td>LOCAL SAP/ARP</td>
<td></td>
</tr>
<tr>
<td>Manufacturing Unit</td>
<td>Factory/Site manufacturing/assembling aircraft parts or sections</td>
<td>Y</td>
<td>LOCAL SAP/ARP</td>
<td></td>
</tr>
<tr>
<td>Programme</td>
<td>SA,LR, A380, A350, etc..</td>
<td>Y</td>
<td>LOCAL SAP/ARP</td>
<td></td>
</tr>
<tr>
<td>Cadence/Quantity avion?</td>
<td>Number of Aircrafts to be manufactured per month</td>
<td>Y</td>
<td>SAP/APC</td>
<td></td>
</tr>
<tr>
<td>Station</td>
<td>Manufacturing / Assembly phase, where Work Order is launched to call off supply</td>
<td>Y</td>
<td>LOCAL SAP/ARP</td>
<td></td>
</tr>
<tr>
<td>Motorisation</td>
<td>Customized Engine Type</td>
<td>Y</td>
<td>LOCAL SAP??</td>
<td>Particular to St.Eloi</td>
</tr>
<tr>
<td>Code</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Side</td>
<td>Left / Right</td>
<td>Y</td>
<td>LOCAL SAP??</td>
<td></td>
</tr>
<tr>
<td>Missing Parts</td>
<td>As per defined in Performance – SCL. Operations</td>
<td>Y</td>
<td>LOCAL SAP/ARP</td>
<td>KPI to be harmonized</td>
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<tr>
<td>Criticality</td>
<td>Characteristic of the Article related to its importance during the manufacturing / assembly Process</td>
<td>N</td>
<td>Local Knowledge / Applications</td>
<td>High/Medium/Low definition to be agreed</td>
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<tr>
<td>Manufacturing Focal Point</td>
<td>Lean Manufacturing Champion</td>
<td>N</td>
<td>NA</td>
<td></td>
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<tr>
<td>Aircraft Sets Lineside</td>
<td>“Stock” lineside, defined &amp; managed by Manufacturing and usually under the consideration of W.I.P.</td>
<td>N</td>
<td>Local Knowledge / Applications</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>This information would be relevant to the planner.</td>
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### Supplier-product block

<table>
<thead>
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<th>Definition</th>
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<tbody>
<tr>
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<td>PN code to be analyzed</td>
<td>Y</td>
<td>LOCAL SAP/ ARP</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>PN description</td>
<td>Y</td>
<td>LOCAL SAP/ ARP</td>
<td></td>
</tr>
<tr>
<td>Buy Part</td>
<td>Characteristic of PN sourced outside Airbus</td>
<td>Y</td>
<td>LOCAL SAP/ ARP</td>
<td></td>
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<tr>
<td>Airbus Manufactured</td>
<td>Characteristic of PN manufactured within an Airbus Factory/Site</td>
<td>Y</td>
<td>LOCAL SAP/ ARP</td>
<td>List of Airbus Sites</td>
</tr>
<tr>
<td>Supplier</td>
<td>Company manufacturing/providing the part</td>
<td>Y</td>
<td>LOCAL SAP/ BW PROCUREMENT</td>
<td></td>
</tr>
<tr>
<td>Commodity</td>
<td>Family of products with similar characteristics</td>
<td>Y</td>
<td>LOCAL SAP/ BW PROCUREMENT</td>
<td></td>
</tr>
<tr>
<td>Lead Time</td>
<td>Provisioning Cycle duration in number of days, from the calling off the part to delivery to the Airbus facility</td>
<td>Y</td>
<td>LOCAL SAP</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Geographical Location where parts are produced by the supplier</td>
<td>Y</td>
<td>LOCAL SAP/ BW PROCUREMENT</td>
<td></td>
</tr>
<tr>
<td>Planner</td>
<td>Person who is in charge of the ordering/planning parameters and calling off the material depending on the Manufacturing needs</td>
<td>Y</td>
<td>LOCAL SAP/ BW PROCUREMENT</td>
<td></td>
</tr>
<tr>
<td>Unit Price</td>
<td>Average price</td>
<td>Y</td>
<td>LOCAL SAP/ BW PROCUREMENT</td>
<td>Decision needs to be taken, Proc. Price or Average price??</td>
</tr>
<tr>
<td>D1, R1</td>
<td>OTD supplier performance, Product Quality KPI</td>
<td>Y</td>
<td>BW Procurement</td>
<td>Usually reported on Supplier, not at PN level</td>
</tr>
<tr>
<td>Second Source Data</td>
<td>In case of double Source, data related to the Second Supplier</td>
<td>Y</td>
<td>LOCAL SAP/ BW PROCUREMENT</td>
<td>Need for confirmation</td>
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## Supply chain operations block

### 2. Warehousing

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<tr>
<td>Description</td>
<td>PN description</td>
<td>Y</td>
<td>LOCAL SAP/ARP</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>Product weight (kg.)</td>
<td>N (partially extracted, but usually not informed in SAP)</td>
<td>Engineering Systems?, LOCAL SAP, ARP</td>
<td>Please, see Weight Packed unit</td>
</tr>
<tr>
<td>Volume</td>
<td>Product Volume (m³)</td>
<td>N (partially extracted, but usually not informed in SAP)</td>
<td>Engineering Systems?, LOCAL SAP, ARP, if informed</td>
<td>Please, see Volume Packed unit</td>
</tr>
<tr>
<td>Weight Packed Unit</td>
<td>Product Weight while still on original packaging</td>
<td>N</td>
<td>LOCAL SAP, ARP, if informed</td>
<td>Relevant to Warehousing Logistics, Depending on Batch size (EOQ)</td>
</tr>
<tr>
<td>Weight Packed Unit</td>
<td>Product Volume while still on original packaging</td>
<td>N</td>
<td>LOCAL SAP, ARP, if informed</td>
<td>Relevant to Warehousing Logistics, Depending on Batch size (EOQ)</td>
</tr>
<tr>
<td>Small Dimension, Medium Dimension, Large Dimension</td>
<td>Product Clustering depending on Size</td>
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<td>Detail analysis to be carried out</td>
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<tr>
<td>Small Size Packed, Medium Size Pack, Large Size Packed</td>
<td>Product Clustering depending on Package Size</td>
<td>N</td>
<td>Detail analysis to be carried out</td>
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</tr>
<tr>
<td>Reusable Packaging</td>
<td>Characteristic of the Packaging</td>
<td>N</td>
<td>Detail analysis to be carried out</td>
<td></td>
</tr>
<tr>
<td>Supplier Packaging</td>
<td>Characteristic of the Packaging from a Standard Multiple choice</td>
<td>N</td>
<td>Detail analysis to be carried out</td>
<td>Relevant to Warehousing Logistics, Depending on Product nature, Supplier Location and Consumption (Milkrun/Loop)</td>
</tr>
<tr>
<td>Refrigerated Material</td>
<td>Characteristic of PN requiring Refrigerated Storage means. Eg: Carbon Fiber Prepregs</td>
<td>Y</td>
<td>LOCAL SAP, ARP</td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>---</td>
<td>----------------</td>
<td></td>
</tr>
<tr>
<td>Shelf life</td>
<td>PN usable until expiring date</td>
<td>Y</td>
<td>LOCAL SAP, ARP</td>
<td></td>
</tr>
<tr>
<td>ESB</td>
<td>Electrostatic Protection required</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Hazardous Material</td>
<td>Materials that required particular warehousing and handling conditions due to toxicity, etc.</td>
<td>Y</td>
<td>LOCAL SAP, ARP</td>
<td></td>
</tr>
<tr>
<td>Quality Inspection Required</td>
<td>Obligation to Quality check the material (NDT, etc)</td>
<td>Y</td>
<td>LOCAL SAP, ARP</td>
<td></td>
</tr>
<tr>
<td>Incoming Lead time</td>
<td>For material with above mentioned obligation, duration of the Quality cycle until the material is available to be used.</td>
<td>?</td>
<td>LOCAL SAP, ARP</td>
<td>Skip lot policy?</td>
</tr>
<tr>
<td>Storage Media</td>
<td>Means used for storage and storage type description</td>
<td>N</td>
<td>Detail analysis to be carried out</td>
<td>Relevant to Logistics Costs</td>
</tr>
<tr>
<td>Physical Warehouse</td>
<td>Warehouse Name - Code</td>
<td>Y</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>IT SAP Warehouse</td>
<td>MM/WM SAP Warehouse</td>
<td>Y</td>
<td>LOCAL SAP</td>
<td></td>
</tr>
<tr>
<td>Warehouse Location</td>
<td>Geographical Location of the Warehouse</td>
<td>Y</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Service Provider</td>
<td>Company that runs Warehousing operations on behalf of Airbus</td>
<td>Y</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Service Provider focal Point</td>
<td>Airbus Employee in charge of the Service Provision management</td>
<td>Y</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Supplier Batch Size (units)</td>
<td>Quantity of parts delivered by the supplier</td>
<td>Y</td>
<td>LOCAL SAP</td>
<td>Linked to the EOQ</td>
</tr>
<tr>
<td>Max. Stock</td>
<td>Upper limit for material in stock</td>
<td>Y</td>
<td>LOCAL SAP</td>
<td>Linked to the EOQ</td>
</tr>
<tr>
<td>Maximum Volume in Warehouse</td>
<td>Warehousing Volume required to store the Maximum Stock</td>
<td>N</td>
<td>Detail analysis to be carried out</td>
<td>Applies to Material with Max defined. Link to cadence</td>
</tr>
<tr>
<td>Maximum Surface</td>
<td>Warehousing Surface required to store the Maximum Stock, in case the media is Ground</td>
<td>N</td>
<td>Detail analysis to be carried out</td>
<td>Applies to Material with Max defined. Link to cadence</td>
</tr>
<tr>
<td>Min. Stock</td>
<td>Lower limit for material in stock</td>
<td>Y</td>
<td>LOCAL SAP</td>
<td>Linked to the EOQ</td>
</tr>
<tr>
<td>Minimum Volume in Warehouse</td>
<td>Warehousing Volume required to store the Minimum Stock</td>
<td>N</td>
<td>Detail analysis to be carried out</td>
<td>Applies to Material with Min defined. Link to cadence</td>
</tr>
</tbody>
</table>
### Minimum Surface in Warehouse

<table>
<thead>
<tr>
<th>Minimum Surface in Warehouse</th>
<th>Warehousing Surface required to store the Minimum Stock, in case the media is Ground</th>
<th>N</th>
<th>Detail analysis to be carried out</th>
<th>Applies to Material with Min defined. Link to cadence</th>
</tr>
</thead>
</table>
### Standard Delivery Solution Information

<table>
<thead>
<tr>
<th>Information Field</th>
<th>Definition</th>
<th>Information Available (Y/N)</th>
<th>System/Source</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component</td>
<td>PN code to be analyzed</td>
<td>Y</td>
<td>LOCAL SAP/ARP</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>PN description</td>
<td>Y</td>
<td>LOCAL SAP/ARP</td>
<td></td>
</tr>
<tr>
<td>Manufacturing Focal Point</td>
<td>Lean Manufacturing Champion, in charge of requirements definition and proposed SLA agreement</td>
<td>Y</td>
<td>NA</td>
<td>Relevant to Warehousing Logistics, distribution. Depending on Product nature, and manufacturing requirements</td>
</tr>
<tr>
<td>Distribution Packaging</td>
<td>Characteristic of the Packaging/conditioning required for distribution from a Standard Multiple choice</td>
<td>N</td>
<td>Detail analysis to be carried out</td>
<td></td>
</tr>
<tr>
<td>Delivery Mean - FDU</td>
<td>Fix Service Unit - The materials are delivered to the Parking close to the Station. Delivery triggered by WO or Kanban Signal.</td>
<td>N</td>
<td>Detail analysis to be carried out</td>
<td>Definition / Agreement with Customer required</td>
</tr>
<tr>
<td>MDU</td>
<td>Mobile Service Unit – The materials are picked to a trolley that will be distributed to the station via internal distribution loops. Linked to MSN, delivery is usually trigger by WO.</td>
<td>N</td>
<td>Detail analysis to be carried out</td>
<td>Definition / Agreement with Customer required</td>
</tr>
<tr>
<td>Skrewbox</td>
<td>Materials are picked for one MSN or a limited period of time (day/week consumption), usually more rotation than Free Disposal. Logistics and handling costs vs variability reduction, better planning &amp; reduction of obsolescence</td>
<td>N</td>
<td>Detail analysis to be carried out</td>
<td>Definition / Agreement with Customer required. Trend defined by Lean / ALPS</td>
</tr>
<tr>
<td>Free Disposal</td>
<td>Materials are delivered to lineside racks and available to Blue Collars. Quantities are defined by consumption over period of time and delivery is triggered by kanban signal</td>
<td>Y</td>
<td>Detail analysis to be completed</td>
<td>Definition / Agreement with Customer required on Quantities</td>
</tr>
<tr>
<td>Delivery Address*****</td>
<td>Physical Location where the material has to be delivered to be used</td>
<td>Y</td>
<td>LOCAL SAP/ARP</td>
<td>Definition / Agreement with Customer required on Quantities</td>
</tr>
<tr>
<td>D-2, D-1, Daily, To Shift, Weekly, Monthly, Delivery time</td>
<td>Delivery requirements definition</td>
<td>N</td>
<td>Existing SLA's</td>
<td>Definition / Agreement with Customer required on Quantities</td>
</tr>
</tbody>
</table>
### Appendices

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Y/N</th>
<th>LOCAL SAP/ARP</th>
<th>Definition / Agreement with Customer required on Quantities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Warehouse of Origin</strong></td>
<td>Warehouse where material is stored and from where must be delivered</td>
<td>Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Service Provider</strong></td>
<td>Company that runs Warehousing operations on behalf of Airbus</td>
<td>Y</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td><strong>Service Provider Focal Point</strong></td>
<td>Airbus Employee in charge of the Service Provision management</td>
<td>Y</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td><strong>Service Price</strong></td>
<td>Contractual Unit Price for Unit delivery</td>
<td>Y, but not in all cases</td>
<td>Contracts</td>
<td>Open Book / Unit Cost Model</td>
</tr>
<tr>
<td><strong>SOP</strong></td>
<td>Standard Operation Process for delivery</td>
<td>Y</td>
<td>Local Organisations</td>
<td>Standardisation required by Commodity, Delivery Unit</td>
</tr>
</tbody>
</table>