

Msc International Business
Master Thesis No 2003:50

**The Upward Strategic Migration of an
Automotive Manufacturing Plant**

**A Case Study of
“Volvo Bus de México”
and the impact of becoming a
Chassis Part Number Factory**

Andrea Salvador

Ramsin Yakob

Graduate Business School
School of Economics and Commercial Law
Göteborg University
ISSN 1403-851X
Printed by Elanders Novum

Abstract

*“Now this is not the end. It is not even the beginning of the end.
But it is, perhaps, the end of the beginning.”*

Sir Winston Churchill

Markets have evolved rapidly over the decades. Low cost, low skill manufacturing plants have been able to take on new roles, allowing companies in various countries to reinforce their competitive priorities. The manufacturing strategy by which these plants operate influences their ability to respond to its internal and external environment.

One industry taking advantage of these global opportunities is the Automotive Manufacturing Industry. Volvo Bus de México is within this industry operating as a Completely Knocked Down Chassis Assembly Plant and wishes to upgrade to a Part Number Factory.

Several operational issues and concerns will arise when undertaking this upgrade, and these will require substantial focus and efforts to resolve. In particular cost, systems, supplier, process, BOM, DCN, and HR needs are issues that need to be addressed. In order to resolve these, a manufacturing plant will need to improve its cost understanding, undertake a systems upgrade, increase the flow of information, develop its processes, improve its supplier relationships and increase knowledge.

This will furthermore have implications for the competitiveness of the plant with regards to costs, quality, delivery, flexibility, capability development, and independability. In particular it becomes evident that the impact on flexibility, capability development and independability will be positive whereas the effect on the other three will neither be positive or negative in the short run.

Keywords:

Volvo Bus de México, Manufacturing Strategy, CKD Chassis Assembly Plant, Part Number Factory, Operational issues, Competitive Priorities.

Acknowledgement

If it were not for the assistance, support, and encouragement of many people, this thesis could not have been written. We would like to acknowledge all of those who in some way or another contributed to the culmination of this important stage in our education.

First, we would like to thank The School of Economics and Commercial Law, Göteborg University, and Prof. Claes Göran Alvstam, Prof. Jan-Erik Vahlne, and Associate Professor Inge Ivarsson for their support during the writing of this thesis.

We would like to express our special thanks to Mr. Kent Olsson who provided us with all the support and guidance throughout our investigation, and during our field study research at Volvo Bus de Mexico. Also, we would like to express our gratitude to his wife, Britt Olsson, for her warm reception during our stay in Mexico.

To all the Managers and employees at Volvo Bus de Mexico who we approached in our short but productive stay, we would like to express our appreciation of their interest, assistance and honesty during our visit.

We would also like to show our appreciation to the people we talked to at Volvo Bus Corporation and at Volvo Bus Borås, who provided us with a clear background understanding at the beginning of our research.

Finally, we would like to thank our families for their encouragement and support throughout this Master Program.

Gothenburg, 5th December 2003

.....
Andrea Salvador

.....
Ramsin Yakob

List of Abbreviations

BOM	-	Bill of Material
CKD	-	Completely Knocked Down
DCN	-	Design Change Notification
GPS	-	Global Purchasing System
JIT	-	Just In Time
MRP	-	Material Requirement Planning
PED	-	Process Engineering Department
PDED	-	Product Development Engineering Department
PDM	-	Product Document Management
PM	-	Product Modifications
PN	-	Part Number; specific item or material used in production
PN Factory	-	Part Number Factory
SEM	-	Supplier Evaluation Model
TNC	-	Trans National Corporation
VBB	-	Volvo Bus Borås
VBC	-	Volvo Bus Corporation
VBM	-	Volvo Bus de Mexico

Table of contents

PART I – RESEARCH FRAMEWORK	- 1 -
1 INTRODUCTION.....	- 1 -
1.1 BACKGROUND	- 1 -
1.2 VOLVO BUS CORPORATION.....	- 4 -
1.2.1 <i>Volvo Bus de México</i>	- 5 -
1.3 PROBLEM DISCUSSION	- 8 -
1.4 PROBLEM FORMULATION	- 14 -
1.5 PURPOSE	- 14 -
1.6 DELIMITATIONS.....	- 15 -
1.7 THESIS DISPOSITION.....	- 16 -
2 METHODOLOGY.....	- 17 -
2.1 THE CASE STUDY DESIGN.....	- 17 -
2.1.1 <i>The Case Study Approach</i>	- 18 -
2.2 CONDUCTING THE CASE STUDY	- 18 -
2.2.1 <i>Conducting the Interviews</i>	- 21 -
2.2.2 <i>Secondary Data Collection</i>	- 23 -
2.3 ANALYSING THE CASE STUDY FINDINGS.....	- 24 -
2.3.1 <i>Criteria for interpreting the findings</i>	- 24 -
2.3.2 <i>Relevance & Quality</i>	- 25 -
2.4 CRITICAL REVIEW	- 27 -
3 THEORETICAL FRAMEWORK	- 29 -
3.1 MANUFACTURING STRATEGY	- 29 -
3.1.1 <i>Competitive priorities</i>	- 33 -
3.2 RESOURCE BASED VIEW	- 38 -
3.3 CONCEPTUAL RESEARCH MODEL.....	- 40 -
PART II – EMPIRICAL FINDINGS.....	- 45 -
4 MEXICO AND THE AUTOMOTIVE INDUSTRY.....	- 45 -
4.1 MEXICO.....	- 45 -
4.2 GLOBAL & MEXICAN AUTOMOBILE INDUSTRY.....	- 47 -
4.3 GLOBAL & MEXICAN BUS TRANSPORT SECTOR	- 51 -
5 EMPIRICAL FINDINGS VOLVO BUS DE MÉXICO.....	- 53 -
5.1 VOLVO BUS DE MÉXICO OPERATIONAL AREAS	- 53 -
5.1.1 <i>Product Development Engineering</i>	- 55 -
5.1.2 <i>Process Engineering</i>	- 55 -
5.1.3 <i>Beredning</i>	- 56 -
5.1.4 <i>Production</i>	- 58 -
5.1.5 <i>Purchasing</i>	- 58 -
5.1.6 <i>Logistics</i>	- 59 -
5.1.7 <i>Traffic</i>	- 60 -
5.1.8 <i>Warehouse</i>	- 61 -
5.1.9 <i>Finance</i>	- 62 -
5.1.10 <i>Information Technology</i>	- 62 -

5.2	MAIN ISSUES AND CONCERNS OF VBM OPERATIONAL AREAS	- 63 -
5.2.1	<i>Cost</i>	- 64 -
5.2.2	<i>Systems</i>	- 69 -
5.2.3	<i>Suppliers</i>	- 79 -
5.2.4	<i>Process</i>	- 84 -
5.2.5	<i>Bill of Material (BOM)</i>	- 94 -
5.2.6	<i>Design Change Notification (DCN)</i>	- 99 -
5.2.7	<i>Human Resource Needs</i>	- 103 -
5.2.8	<i>Others</i>	- 106 -
PART III – ANALYSIS, CONCLUSION & RECOMMENDATIONS.....		- 111 -
6	ANALYSIS.....	- 111 -
6.1	ANALYSIS OF THE ISSUES AND CONCERNS IDENTIFIED.....	- 111 -
6.1.1	<i>Costs</i>	- 112 -
6.1.2	<i>Systems</i>	- 114 -
6.1.3	<i>Suppliers</i>	- 115 -
6.1.4	<i>Process</i>	- 118 -
6.1.5	<i>Bill of Material (BOM)</i>	- 119 -
6.1.6	<i>Design Change Notification DCN</i>	- 120 -
6.1.7	<i>Human Resource Needs</i>	- 121 -
6.1.8	<i>Others</i>	- 122 -
6.2	ANALYSIS OF THE IMPACT ON COMPETITIVE PRIORITIES	- 124 -
6.2.1	<i>Cost Efficiency</i>	- 125 -
6.2.2	<i>Quality</i>	- 127 -
6.2.3	<i>Delivery</i>	- 129 -
6.2.4	<i>Flexibility</i>	- 130 -
6.2.5	<i>Competence and Capability Development</i>	- 133 -
6.2.6	<i>Independability</i>	- 135 -
7	CONCLUSION	- 137 -
8	RECOMMENDATIONS	- 143 -
9	FURTHER RESEARCH AREA	- 151 -
10	REFERENCE LIST	- 153 -
11	APPENDIX	- 161 -

List of Figures

FIGURE 1 DIFFERENT PLANT STRUCTURES FOR MANUFACTURING CHASSIS.....	- 11 -
FIGURE 2 OPERATIONAL AREAS IN AN AUTOMOBILE MANUFACTURING PLANT ...	- 12 -
FIGURE 3 INVESTIGATION MODEL	- 14 -
FIGURE 4 THESIS DISPOSITION	- 16 -
FIGURE 5 ANALYTICAL APPROACH.....	- 20 -
FIGURE 6 CONCEPTUAL RESEARCH MODEL.....	- 43 -
FIGURE 7 ORDER TO DELIVERY SYSTEM.....	- 54 -
FIGURE 8 REASONS BEHIND THE RISE OF ISSUES AND CONCERNS	- 111 -
FIGURE 9 IMPACT ON COMPETITIVE PRIORITIES	- 124 -
FIGURE 10 CONCLUDED INVESTIGATION MODEL	- 137 -

List of Tables

TABLE 1 TARIFF ELIMINATION SCHEDULE FOR AUTO-PARTS 2000 - 2007	- 46 -
TABLE 2 RULES OF ORIGIN (PERCENT OF REGIONAL CONTENT)	- 47 -
TABLE 3 MAIN ISSUES AND CONCERNS AT VBM	- 64 -
TABLE 4 IMPACT ON VBM COMPETITIVE PRIORITIES	- 140 -

List of Appendix

APPENDIX 11-1 PRODUCTION BY COUNTRY & VEHICLE TYPE 1998 - 2004.....	- 161 -
APPENDIX 11-2 SALES BY COUNTRY & VEHICLE TYPE 1998 - 2004.....	- 161 -
APPENDIX 11-3 VBB CURRENT STRUCTURE	- 162 -
APPENDIX 11-4 VBM CURRENT STATE MAP.....	- 163 -
APPENDIX 11-5 THE BASIC AUTOMOBILE PRODUCTION CHAIN.....	- 164 -
APPENDIX 11-6 INTERVIEW PARTICIPANTS.....	- 165 -
APPENDIX 11-7 DICKEN - DEVELOPMENT SEQUENCE.....	- 166 -
APPENDIX 11-8 FERDOW – THE ROLE OF PLANTS AND STRATEGIC CONTENTS	- 167 -
APPENDIX 11-9 PRODUCTION IN MEXICO & VEHICLE TYPE 1998 - 2004.....	- 169 -
APPENDIX 11-10 WORLD: ACTUAL & FORECAST BUS & COACH SALES TO 2005 -	169 -
APPENDIX 11-11 MEXICO: PRODUCTION OF BUSES & COACHES 1995 - 2001.....	- 170 -
APPENDIX 11-12 MEXICO: ACTUAL & FORECAST BUS & COACH SALES 2005.....	- 170 -
APPENDIX 11-13 IT STRUCTURE – TO BE COMPLETE BUS SYSTEM.....	- 171 -
APPENDIX 11-14 LINK BETWEEN ISSUES AND COMPETITIVE PRIORITIES	- 172 -

Part I – Research Framework

1 Introduction

This chapter will provide a clear guidance to the main purpose of this thesis. Here, we will start with a general background discussion to the subject, followed by a concrete presentation of the case company we chose to work with. We then present the establishment of the problem formulation, purpose and delimitations, and finally conclude with an illustration of the thesis outline.

1.1 Background

The global marketplace has been changing at a tremendous speed over the last few decades as a response to the dynamic forces of globalisation and its impact. For nations all over the world the changes have had significant meaning. Nations that previously were considered as merely low cost, low skill production locations have as a result of the changing global environment been able to take on new roles. The high level of development that has taken place in these nations has made this possible. The increasing and intertwining of economies, and the increase of large multinational companies spreading their facilities all over the globe have been one reason for bringing about these changes. The new global environment has not only meant that new potential markets have emerged for the sale of products; equally important or perhaps even more important has been the access to low cost production areas. This has allowed companies to undertake significant investments in manufacturing facilities in various countries in an attempt to reduce production costs and take advantage of mass production economies of scale. This has furthermore allowed them to take advantage of factors that will impact on their ability to compete in national as well as international markets.

In addition to this, the dynamic globalisation forces have furthermore brought with it new and increased level of competition, spread of technology, finance, know-how and has meant that new challenges and opportunities to strategic decision making has arisen. In combination with rapid host country economic progress, advances in communication technology, infrastructure, and increase in educational levels the role that can be played by foreign manufacturing facilities has changed as well. The argument is simply that whatever the

rationale behind establishing a foreign manufacturing facility in the first place, the strategic role of foreign factories can evolve over time.¹ This includes a change in the manufacturing role and operating responsibilities of plants and the way they can focus on developing new competitive advantages.

As a result, many nations are becoming potential centres for sophisticated design, product development and manufacturing operations. Consequently, factories based in these nations are now able to take on a greater strategic role in different areas of expertise.² These will arguably also be in a better position to develop their competitiveness towards other companies.

Foreign factories arguably upgrade their capabilities as a result of improvements coming from predominantly two sources. One can be central pressure to improve a factory's cost structure or to customise a product to the demands of local consumers. This can lead to the development of additional capabilities of a factory. A second source can be the increasing abundance of advanced factors of production in the host nation. No matter what the reason is, economic development in many emerging and newly industrialised nations has given new opportunities for foreign factories to create new competitive capabilities.³ These new capabilities can help a manufacturing plant to increase their ability to compete on competitive factors such as price and quality, as well as the ability to respond to new markets demands.

The idea of dispersed manufacturing centres developing is consistent with the concept of a Trans-National Company (TNC) strategy. This often involves the location of production facilities in global areas where the greatest benefits can be obtained and includes a belief in global learning. In addition to this, a choice must be made of what function to place in each country. TNC's by definition, place some productive functions or operational areas in host countries, whilst keeping others at headquarter (from hereon referred to as HQ) level.⁴

However, all operational areas cannot be located abroad with equal ease due to their different roles and characteristics. Some need to be located near each other or near advanced economic or innovation centres or be close to the HQ. Others need to reach a critical minimum size in order to serve global or

¹ Hill, 2001

² ibid

³ ibid

regional needs efficiently or can be divided into discrete stages and be located far apart according to cost considerations. New communication and organisational technologies have changed the optimal location of each function. The old model of TNC's retaining critical functions at HQ's and letting affiliates reproduce other functions in each host country is giving way to a more coherent and integrated location pattern.⁵ By this, foreign manufacturing plants that once only had a limited set of manufacturing capabilities or roles, can start taking on a greater strategic role and furthermore give a greater contribution to the overall competitiveness of the corporation.

As a result, the evolvement of more strategic international plants is becoming a reality. This includes more empowerment and less reliance on HQ taken decision and set directives. Upgrading their capabilities allow foreign factories to make decisions regarding critical functions in an efficient manner, consequently allowing them to respond faster in the evolving environment they are working and competing in. Foreign factories that upgrade their capabilities and operations over time are creating valuable knowledge that might benefit the whole corporation.⁶

One industry that has gone through consolidation pressures in the last decades, and that is able to take advantage of global opportunities, is the automobile manufacturing industry. The reason for this is the true global characteristics of the industry, with dispersed manufacturing plants located in many developing countries. One company currently operating in this environment and under these conditions is Volvo Bus Corporation (VBC). This company has dispersed manufacturing plants located in many developing countries, and is also influenced by the globalisation forces giving rise to opportunities to develop their foreign manufacturing plants. One such manufacturing plant is Volvo Bus de Mexico (VBM), located in Mexico City.

Volvo Bus de Mexico has recognised the potential to increase the strategic role it can play as a foreign manufacturing plant, and has therefore, taken an increased interest in what the implications for its manufacturing operations would be if it undertook such a change. Hence, Volvo Bus de Mexico can be used as a case company to provide further understanding to what needs to be

⁴ Hill, 2001

⁵ United Nations, 2001

⁶ Wild, et. al., 2003

taken into consideration for an automobile manufacturing plant seeking to upgrade its strategic role, the operational issues and concerns that might arise, as well as providing understanding as to what the impact on its competitiveness would be.

1.2 Volvo Bus Corporation

Volvo Bus de Mexico is part of Volvo Bus Corporation (VBC), the third largest business area within the Volvo Group. Although VBC historically has mainly been focused on the development and production of chassis, the company has in later times acquired body-manufacturing capabilities as well.⁷ This has allowed VBC to change from being a manufacturer of a small range of bus chassis to being the second largest bus manufacturer in the world, with affiliates all around the globe. Production and assembly takes place in many countries although the manufacture and development of engines, gearboxes, and axles, are primarily carried out in Sweden.⁸

In Latin America, Volvo is amongst the thirteen biggest vehicle manufacturers, although its total vehicle production is quite low compared to big competitors such as Volkswagen and General Motors.⁹ Additionally, Volvo's production in Latin America is mainly divided between Brazil and Mexico. Between these two markets, the Mexican only constitutes a smaller number of produced Volvo Buses but due to the potential of the market, it should not be underestimated. The production data of VBC in Latin America corresponding 1998 to 2004 can be found in Appendix 11-1 and 11-2.

However, VBC is facing new and hardened competition from many other bus manufactures, which are all competing for market shares in a stagnating market. According to former President of Volvo Bus Corporation Jan Engström:

*“The competition on the market for public transport is harder now than ever before. This in turn means that demands on the vehicle's quality, flexibility, and total economy are all increasing”.*¹⁰

⁷ Weimark, 2000

⁸ Volvo Bus Borås, 2003

⁹ Andrew, 1999

¹⁰ Volvo Bus Borås, 2003

This has also meant that customer demands for Volvo Buses to offer greater flexibility and a wider range of models have increased. For one, customers want to be able to choose and adapt Chassis to meet local requirements. In addition to this, Håkan Karlsson, CEO and President of Volvo Buses, believes that:

*“Lead times in the bus industry are too long.
We must focus more on industrial efficiency”.*¹¹

In the light of the new competitive challenges, one of VBC’s foreign manufacturing plants, namely Volvo Bus de Mexico is contemplating a strategic upward migration of its manufacturing capabilities. By this, they believe that they can be better positioned to react and respond to new challenges and threats, which it might face in the future.

1.2.1 Volvo Bus de México

The history of Volvo Bus de Mexico (VBM) can be traced back to Mexicana de Autobuses SA de CV (MASA), created in 1959. In September 1998 MASA was bought by VBC in a deal that involved a one hundred percent acquisition. MASA’s operations were basically divided into two: the production of urban, suburban and tourism Buses and the assembly of Bodywork on Chassis, provided by third parties.¹²

VBM as it now is called has been carefully modernised and brought up to VBC’s international standards. Volvo has had very rewarding years in Mexico and an increase in production and number of employees has put VBM in an honourable position of being the biggest bus producer in the country.¹³

In 2002, the company won orders to build 2,000 coaches and buses over a three year period for three customers.¹⁴ The contract covers the delivery of around 600 buses a year, with a total worth of 3 billion SEK. This delivery was programmed to start in the middle of 2002 and continue to the middle of the

¹¹ Volvo Bus News, 2003

¹² www.volvo.com

¹³ www.volvotrucks.volvo.com

¹⁴ Jack & Gibbins, 2002

year 2005.¹⁵ Moreover, in three years of VBM establishing its operations in Mexico, it has become the second largest supplier (25 percent in 2001) within the coach segment. The market leader with 29 percent of the market share is Mercedes Benz.¹⁶

VBM is currently operating as a Completely Knocked Down (CKD) Assembly Plant, or a “Kit-Factory” for its Chassis parts. This means that all necessary parts for the construction of a Chassis is imported in one CKD Kit and assembled at the plant. These necessary parts are mainly imported from Sweden.¹⁷ The CKD Assembly line for Chassis corresponds mainly to the TX 9700 Volvo model.

Moreover, during the last years, VBM has been able to upgrade its operations from a CKD Assembly Plant and become a Part Number (PN) Factory for its body production. For this, the company is mostly dependant on local suppliers who provide the company with the necessary material for the construction of the Bus Body. A more detailed and clearer description regarding the characteristics of a CKD Chassis Assembly Plant and a PN Factory will be given shortly in the problem discussion.

Looking closer at the Chassis assembly and the process of using imported CKD Kits, it becomes apparent that VBM is heavily dependant on one of the main Chassis CKD Plants and producers of Chassis within VBC, namely Volvo Bus Borås (VBB). VBB was built in 1976-77, when it started operating as a Chassis manufacturer. It includes around 45 blue and white-collar employees, and builds most of the Chassis for Volvo in its installations.¹⁸

VBB is currently divided into five main divisions to handle the different business regions around the world. The main responsibilities that VBB has relate not only to order handling, in-planning, packing the material, invoicing, transportation issues together with Volvo Logistics, but also local manufacturing support, project co-ordination for new products and new CKD Plants, quality follow up and general support to all CKD Plants around the globe.¹⁹ Please refer to Appendix 11-3 for the VBB Current Structure.

¹⁵ Bussbranschen, 2002 (1)

¹⁶ Bussbranschen, 2002 (2)

¹⁷ Alvstam & Ivarsson, 2003

¹⁸ Volvo Bus Borås, 2003

¹⁹ ibid

Since the establishment of VBM's in Mexico in 1998, there has been a close relationship between these two plants. Hence the dependability on VBB is important for VBM's Chassis assembly process and its complete bus manufacturing operations, and needs to be understood. It can furthermore be argued that the knowledge for Chassis lies in this plant.²⁰ Please refer to Appendix 11-4 for VBM Current State Map.

Looking closer at VBM organisational structure and its operating areas, it contains four supporting departments, which provide vital assistance and support to the rest of the organisation. These supporting departments include 200 employees and are composed of:²¹

- After Market Services - Services in general, Spare Parts, and Sales;
- Human Resource Area - Administration issues, Salaries, companies' Security system and Personnel;
- Finance Area - Cash flow, Treasury, and Accounting issues;
- Business Process Engineering or the Business Processes Development Area - Process and workflow development.

In addition to these supporting departments, there is the Industrial Department which consists of the Material and Production areas and which could be argued to be most involved in the physical production of Volvo Buses. It includes around 1,400 employees. The responsibilities of the Industrial Department are divided between:

- Production Department - Assembly, In house production, Maintenance.
- Process Engineering - Production Tools, Factory layout, Assembly Processes.
- Purchasing - Emitting the Contracts, making the Purchase, enhancing Supplier Relationships, and taking care of Supplier Quality Assurance.
- Product Development Engineering for Body - Bus Body Development.
- Quality Department - Production Quality.
- Material Department - Responsible for material flow. Contains also Traffic, Beredning, Logistics, Warehouse departments.

²⁰ Volvo Bus Borås, 2003

²¹ Volvo Bus de México, 2003

All these departments work together in the construction of a bus, which exists of two essential activities or parts. These are the assembly or construction of the chassis and the construction of the bus body. Chassis construction is primarily composed of the frame structure, engine, the gearbox and the axels. This constitutes the “base” of a bus to which the second major activity, the connection of the bus body will be made on. There are of course other smaller assembly and manufacturing processes taking place but these two activities are the fundamental ones. A more detailed description of the factors involved in vehicle manufacturing can be seen in Appendix 11-5. As mentioned VBM is interested in follow suit its Body activities and therefore contemplating to upgrade its current Chassis operations to PN Factory status.

1.3 Problem Discussion

As discussed previously, globalisation has influenced the development of companies around the world. The ability a company has to innovate, evolve, change its operational functions or even their facilities are becoming an essential factor for competitive advantage. In order for a TNC to survive, it must have accomplished global scale, international resource access, and worldwide market position. The competitive leaders are the companies that know how to act towards market or technological trends, which show high levels of responsiveness and creativity towards worldwide opportunities and threats and which are able to exploit their new ideas and products globally in a rapid and efficient manner.²²

The reality of global competition is very clear. It means not only an increase in the number of competitors in the world but also a qualitative change in the nature of competitive advantage. Many international companies have sought to achieve lower cost, higher quality, faster product introduction, greater flexibility, and shorter delivery times, all at the same time.

However, these factors are quickly becoming a necessary requirement of global competition and hence a strategy pursued by virtually all global competitors.²³ As a result, alternative ways of reinforcing the competitive advantage must arguably be found.

²² Bartlett & Ghoshal, 1998

²³ Shi & Gregory, 1998

The roles played by international manufacturing plants have become increasingly important in order to develop and strengthen these competitive advantages. In setting up a new international production facility, important strategic and structural decisions need to be considered. They include the size and location of the plant, its capacity, the type of equipment and degree of automation. In addition to this, there are important infra-structural decisions to be taken concerning the skill level of the workforce, the degree of autonomy, and the organisation structure of the plant.²⁴ These decisions are not easy to take and cannot be regarded as not being subject to change. Therefore, they give rise to several questions such as how a company can decide on the strategic and structural configuration for a plant. What does it require in terms of development, expertise, knowledge and responsibility?

Additionally, the dynamic nature of the environment in which firms operate arguably implies that plants need to develop in accordance to this so that they can sustain or acquire new competitive advantage, using their resources and capabilities. By doing so, a company can create a proactive competitive influence rather than a reactive response to its industrial environment.²⁵ This evolution is very apparent in the automobile industry, which has experienced turbulence and restructuring pressures for the last decades. Automobile companies therefore need to rethink the strategic role of their international plants, and find out how they could help to develop new or strengthen competitive advantages.

It is essential for companies to consider different ways by which their assembly and manufacturing plants can operate. This of course also involves decisions on what the role of an Automobile Production or Assembly Plant should be. Does it need to develop in order to obtain new competence, capabilities, and competitive advantage in relation to cost, quality, delivery and flexibility in order to stay competitive?

Two different ways to operate a manufacturing plant is as a Completely Knocked Down Assembly Plant (CKD Assembly Plant) or a Part Number Factory (PN Factory). These two operating modes require a certain set of competence, capabilities, and knowledge. A CKD Assembly Plant refers to a Plant, which imports components (Part Numbers) in the form of CKD Kits' for

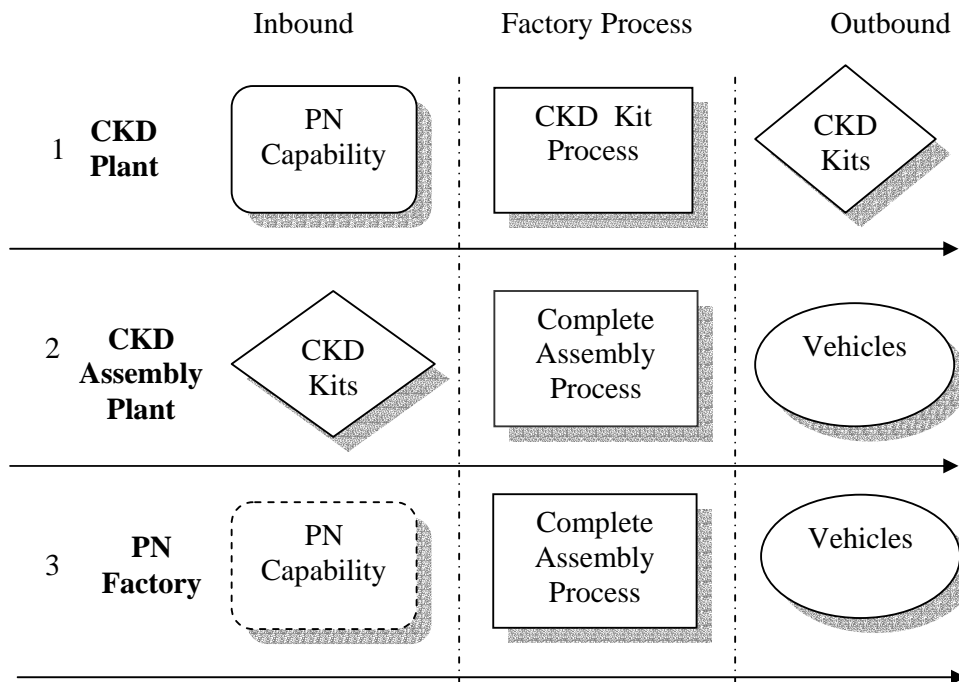
²⁴ Vereecke & Van Dierdonck, 2002

²⁵ Shi & Gregory, 1998

vehicles from CKD Plants around the globe. The notion of a PN Factory is one where the plant has more freedom, responsibility and manoeuvrability to make decision regarding the sourcing of the specific, individual part numbers used in their assembly or production of vehicles.

It is our understanding that the difference between the CKD Assembly Plant classification and being a PN Factory lies in the way the particular material for a bus are obtained. A CKD Plant, which's role is to obtain all the components to manufacture a bus chassis and then pack these in kits and send them to various assemblers worldwide is by definition becoming a CKD Plant only when looking at the end result of its manufacturing/assembly process. Looking only at the way such a plant operates in order to obtain all material used for the chassis, it becomes apparent that it operates as a PN Factory. This is because it needs to source the specific part numbers directly from the suppliers.

A CKD Assembly Plant on the other hand, is defined as such because it is assembling parts of a Bus but is not responsible for the inbound operations of the specific bus components in terms of ordering components directly from the suppliers. Rather it relies on a CKD Plant to deliver these components in kits. If the CKD Assembly Plant was to have responsibility for the direct acquisition of components, it would in essence become a PN Factory. Hence, it is our understanding that it is the inbound operational areas that need to be developed in a CKD Assembly Plant in order to make the strategic upgrading to become a PN Factory. The figure below illustrates these identified differences.

Figure 1 Different Plant structures for manufacturing Chassis

Source: Authors' own elaboration, 2003

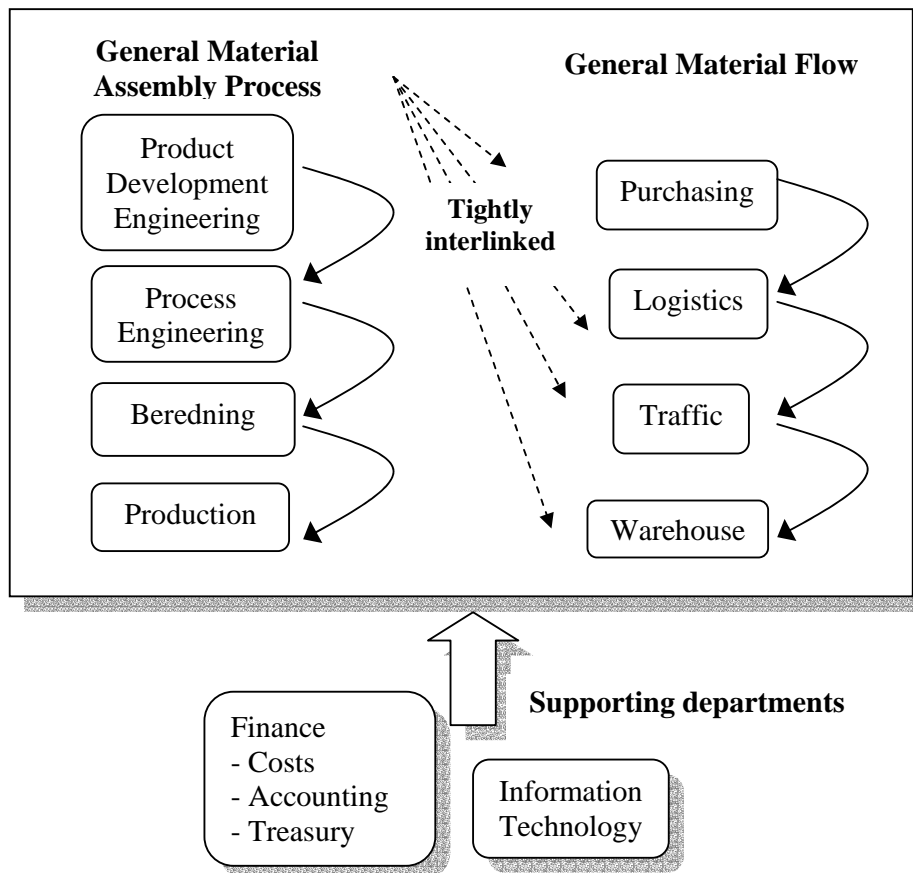
The above mentioned manufacturing modes furthermore requires the operating areas of a manufacturing plant to have a certain set of capabilities, competencies, and knowledge. However, if a plant has not previously operated with the required increase in responsibility that it takes to be a PN Factory for instance, it cannot know what is required. This in turns give rise to an important question such as what the exact nature of the capabilities, competencies and knowledge required to operate in a greater strategic role are?

As explained, the manufacture of buses is dependant on the existence of several operational areas or departments as mentioned in section 1.2.1. More specifically these are Product Development Engineering, Process Engineering, Beredning and Production. These operational areas are essential throughout the manufacturing process as they facilitate the procurement, development and final assembly of the material.

Moreover, these departments are tightly interlinked with the Purchasing, Logistics, Traffic and Warehouse departments in charge of the material flow from the suppliers' plant to the company. These are in turn dependant on the

right support being provided from two other departments, primarily IT and Finance. These supporting areas are involved during the whole transaction process between the other eight operational areas mentioned above. An illustration of these departments is given below.

Figure 2 Operational Areas in an Automobile Manufacturing Plant



Source: Authors' own elaboration, 2003

The above mentioned operational areas are crucial in the construction of a bus as their capabilities and expertise facilitates the ability to operate efficiently. Therefore, they will be heavily impacted by any attempt to strategically upgrade a plant. This is because these operational areas need to be involved in the process which will ultimately lead them taking on a greater responsibility. Nonetheless, the exact implication that such a change will have is not known and needs to be established. What will the impact on these operational areas be? What specific issues and concerns might they have when facing this change? These are questions that if answered could facilitate the process of taking on a greater strategic role.

Moreover, the ability of any automobile manufacturing plant to take on a more strategic manufacturing role cannot be taken for granted. This is arguably because there might be requirements and issues that need to be considered and solved before any such an attempt is taken. Companies need to ask themselves what problems and constraints might arise in the migration process, why do they arise, and how they can be solved? Answering these questions will arguably help to determine what is required for an automobile manufacturing plant to upgrade its operating activities.

The potential increase in responsibilities and the potential identification of issues, concerns, and problems that could arise will also have implications for its ability to compete effectively. This is because it requires increased knowledge and expertise to operate in the two different manufacturing modes described above. Therefore, an understanding of the larger effects of a strategic upward migration needs to be obtained. What will the plant's ability to compete successfully and the impact on its competitive priorities be after the migration? This is also a question that needs to be answered so that the appropriateness of taking on a greater strategic role can be established.

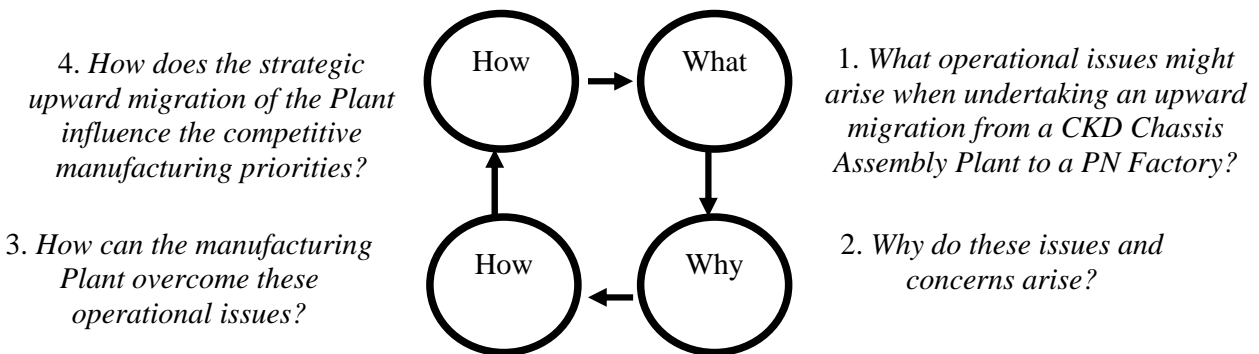
One company contemplating to undertake such a strategic change in its manufacturing role is Volvo Bus de Mexico (VBM). As mentioned earlier, VBM is currently operating as a CKD Chassis Assembly Plant in the Mexico City region. With the need and wish to be better positioned to respond to external and internal forces it is contemplating an upgrade in its Chassis Assembly activities to PN Factory status. Therefore, VBM is seen as an interesting case company to undertake the research into what is needed or what issues might arise in a manufacturing plant that is contemplating to undertake an upward strategic migration and also what this would mean for its competitiveness. By using VBM as a case company we will be able to identify, evaluate, and analyse its possibilities, constraints and readiness level to become a Chassis PN Factory. In addition, we will be able to understand what the potential impacts on the competitive priorities are likely to be.

1.4 Problem Formulation

The problem centres on what needs to be taken into consideration in a CKD Chassis Assembly Plant contemplating to upgrade to a PN Factory. In order to provide an understanding to this main question, several sub-questions require to be answered. The figure below further indicates that these questions are reoccurring over time.

Figure 3 Investigation Model

What does an Automotive Manufacturing Plant need to take into consideration when upgrading from a Completely Knocked Down Chassis Assembly Plant to a Part Number Factory?



Source: Authors' own elaboration

1.5 Purpose

This thesis will emphasis its work on the Order to Delivery Industrial System of VBM and will investigate what needs to be taken into consideration, and the operational issues and concerns that might arise when seeking to become a PN Factory for Chassis. This will be established by focusing on the operational areas in a CKD Chassis Assembly Plant and give an understanding of how they might be affected by such a development. By identifying these, this thesis will also attempt to provide an answer as to why these issues arise and what is required to resolve them. By providing an understanding to the above, this thesis will furthermore try and give an illustration of how this change can influence its competitive manufacturing priorities.

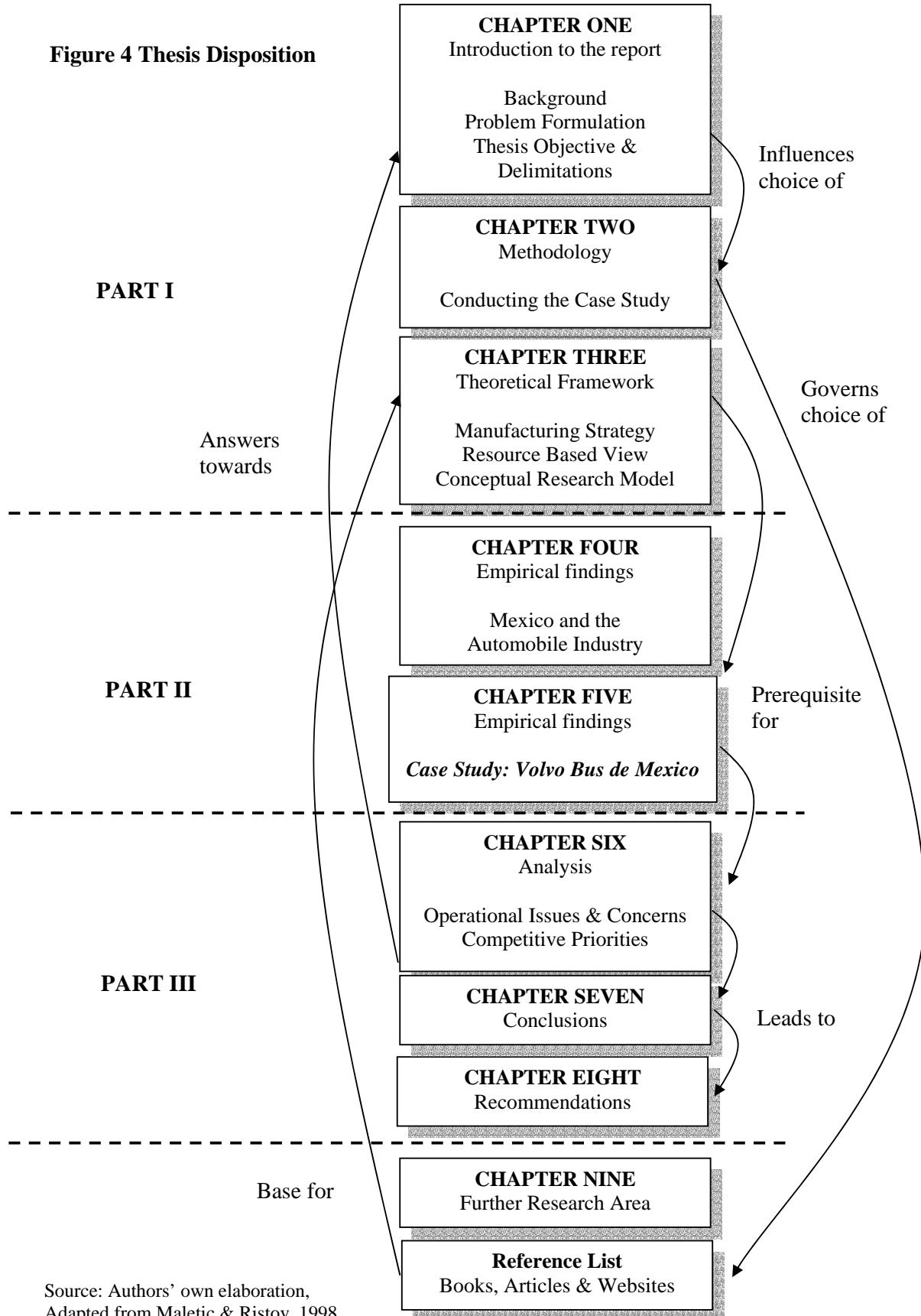
1.6 Delimitations

It should be made clear that this thesis will not cover any benchmarking with other full-scale manufacturers in Mexico. It will only analyse and describe the internal resources and capabilities of a CKD Chassis Assembly Plant. External issues referring to cultural, financial, environmental, and competitors will not be treated in this report. Additionally, no specific supplier analysis will be made as this issue is not perceived as being crucial at this stage of the research. This is because the upgrade will not involve a significant change of suppliers.

As this report will specifically focus on VBM's perspective in Mexico, it will not cover any issues related to the Swedish automobile market. Moreover, since the thesis is related to manufacturing issues, no analysis on the domestic transport industry will be done. It also needs to be mentioned that no attempt to provide clear recommendations regarding implementation strategies as to how the upgrading process should look like. Rather it will highlight the issues and concerns that might arise if a manufacturing plant contemplates to upgrade from a CKD Chassis Assembly Plant to a PN Factory, and how they can be resolved. This thesis will not cover any implications of a strategic upward migration in the future. Rather focus will only be given to the immediate implications.

1.7 Thesis Disposition

Figure 4 Thesis Disposition



Source: Authors' own elaboration,
Adapted from Maletic & Ristov, 1998

2 Methodology

The purpose of this chapter is to present and discuss the method used in this thesis as well as introducing the research strategy and the empirical tools applied. For this study, we used a qualitative case study design as it would allow us to draw upon the experience and knowledge of the people who are closest to the research area investigated. This involved concentrating mainly on primary data gathered through interviews.

2.1 *The Case Study Design*

It has been argued that a variety of different research strategies can be utilised, to describe the appropriate tools or methods used to derive at the conclusions, results and recommendations of a study. These strategies are argued to be field studies, case studies, laboratory experiments, surveys, and action research. According to Tellis (1997), each research strategy is decisive for what type of data and results it is possible to obtain in a study.²⁶

With these five different ways of conducting a research at hand, we decided that the best approach to undertake this study would be to use the case study design as it would best suit the purpose, research topic and problem formulation. This is because the case study approach is an empirical inquiry that incorporates an in-depth investigation of a contemporary phenomenon in a real life context. It is also argued that case studies are especially appropriate in situations where the task is to:

“document a phenomenon within its organisational context, exploring the boundaries of a phenomenon, and integrating information from multiple sources”²⁷

These are characteristics that corresponded very much to our research setting, as we decided to obtain distinctive opinions regarding the upward migration of a manufacturing plant from managers and employees at VBC, VBB and from people working at VBM. The research area was further established to lie within a set organisation, VBM.

²⁶ Tellis, 1997

²⁷ Yin, 1994

2.1.1 The Case Study Approach

According to Yin (1994) there are three different types of case studies, namely, Exploratory, Explanatory, and Descriptive.²⁸ The explanatory case study will look for cause – and – effect relationships and search for explanatory theories of the phenomenon being examined. In an exploratory case study, the collection of data occurs before theories or specific research questions are formulated. It is then followed up by analysis of data and a more systematic case study. The first stage of this type of case studies is to define the issue area to be researched. The descriptive case study on the other hand will require a theory to guide the collection of data and furthermore requires this theory to clearly be stated and serve as the design for the descriptive case study.²⁹

This thesis started out as an exploratory case study, where some collection of data was required in order to establish the research questions. This was because we at an initial stage did not feel that we had enough background knowledge to understand the research area we were to investigate. This allowed us to define an initial research topic and also to formulate the initial problem. Following this, a more descriptive approach was taken as we based our further data collection and research process on a theory that we found was sufficient to provide us with the data and information we required to draw the right analysis, recommendations, and conclusions upon.

2.2 Conducting the Case Study

In order to fulfil the objective of this thesis, we had to carry out certain procedures in the thesis writing process. It is argued that there are three distinct types of scientific reasoning that can be used in a research study. These are Inductive, Deductive and Abductive reasoning. As we at an early stage understood that we had to combine the theoretical and empirical activities throughout the whole project, we felt that an abductive reasoning approach would best suit us. As stated earlier, the reason for this was because we did not have enough knowledge to understand the research area in the beginning. Hence, we felt that we needed an approach that would allow us to develop our study as we gained more knowledge and understanding throughout the project.

²⁸ Tellis, 1997

²⁹ *ibid*

This approach is also supported by Yin (1994) who argues that it is normally crucial in an investigation to interchangeably observe both the theory and the empirical data in order to obtain accurate results.³⁰ Besides which we also decided that in order to fulfil the purpose of this thesis, we needed to undertake a qualitative research, based on qualitative open-ended interviews.

This project continued at the theoretical level after having formulated the research area and main problems. We began by reading manufacturing strategy theories and establishing which ones were most relevant. During this exercise we identified the work of Skinner as being very important. Therefore, we decided to elaborate a preliminary model that could be applied in giving answer to the research questions. This model included the different views that researchers in manufacturing strategy had and allowed us to establish the initial four competitive priorities (cost efficiency, high quality, fast and reliable delivery, and product/process flexibility), as important to consider in the research area.

In addition to this, the work of Kasra Ferdow on the strategic role of manufacturing plants was identified. His research was of interest as it became evident that he had researched the different strategic roles that foreign manufacturing plants could play. This in our belief was very important in our work, as we had understood that the upward migration to become a PN Factory was in essence a question of taking on a more strategic position by a plant. Hence, it became evident that our initial research model had to be modified by two additional priorities in order to fulfil and obtain a more complete investigation, namely Independability and Competence and Capability Development.

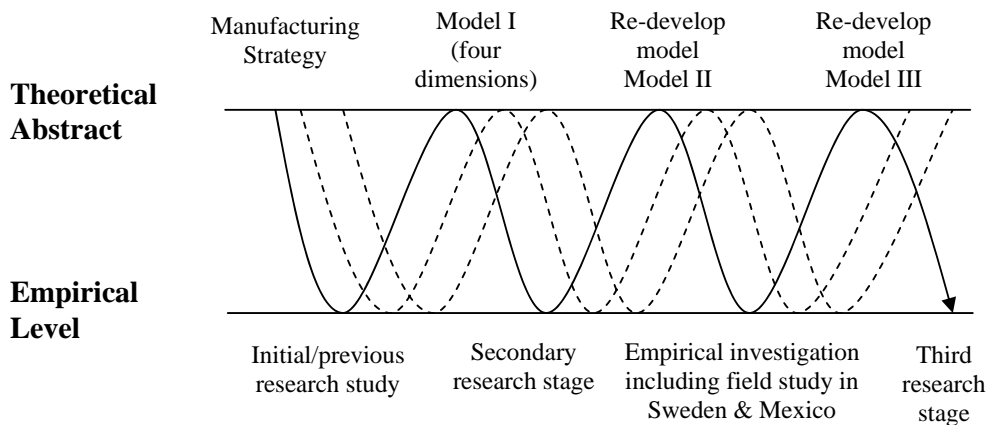
We also identified the need to find a theory or tool that could help us give an answer to how the competitive priorities would be influenced and impacted by issues and concerns that could arise in a potential strategic upward migration of a manufacturing plant. For this, it was decided to use the Resource Based View approach, as it would allow us to approach the operational areas directly and find out what their position was in terms of competence, resources, and capabilities.

³⁰ Yin, 1994

Following this, we re-developed the initial conceptual model and tested it with empirical findings from Sweden and Mexico. We then noticed that the conceptual model was itself not focused enough on the internal issues and concerns of VBM as it still incorporated some external influences. We therefore, elaborated the model once again so that we would have a better view of what structure our investigation had to take and what the relationship between our theoretical understanding and the empirical evidence was.

In all, we believe that by using an abductive approach in this study, the data gathered in the theoretical as well as in the empirical abstract, could be analysed throughout the whole research. This ongoing analytical process between theory and empirical findings helped us answer the main issues related to the problem formulation and the sub problems of the report, develop the conceptual model to better suit the real mission of the investigation and to come up with clear cut recommendations and conclusions at the end. The following figure provides a sum up of the most important sections in the abductive approach taken in this report:

Figure 5 Analytical Approach



Source: Authors' own elaboration, adapted from case study seminar 16th May 2003

2.2.1 Conducting the Interviews

It is argued that the data collection in a case study should focus on an extensive interview process supported by data from other relevant documents. This is because one of the goals of a case study is to offer new variables and questions for further research.³¹ In order to answer the main problem of this investigation, empirical research was conducted in Sweden and in Mexico. This includes both the collection of primary and secondary data.

Primary data is data collected directly from the source, and is specific for the research conducted. In a case study, one of the most important sources of data collection is conducting interviews as this type of data also arguably has the highest validity and quality.³² Therefore, we decided to rely mostly on this type of research information.

In this thesis we used qualitative open-ended personal interviews. The benefits of personal interviews is, the fact, that it will create more opportunity to respond to reactions not expressed in words, such as body language and other non-verbal reactions. It also creates opportunities to respond to other things said during the interview, and an open discussion can be held easier when talking to subjects in person.³³ In addition to this, the use of open-ended questions allowed us to continue the dialogue by using the interviewees' insight comments as the basis for further questions.

Since the thesis main aim was to identify what needs to be taken into consideration if VBM were to become a PN Factory for Chassis, we decided to start our interviews at VBB. As explained earlier in the report, VBB is an important Volvo manufacturing plant for Chassis, reinforcing the reason behind why the information we could obtain there was a good starting point for this investigation. Soon after establishing VBB's opinion regarding the main problem of this thesis, we approached Volvo HQ, in order to establish their opinion and views.

³¹ Coates, & McDermott, 2002

³² Kinnear & Taylor, 1991

³³ *ibid*

After being able to fulfil the field study in Sweden, we visited the CKD Chassis Assembly Plant in Mexico (VBM). Our aim was to establish VBM's middle and top management opinion regarding the current situation, and to determine the internal resources and capabilities existing in the company. It also became clear to us, that certain operational areas had to be investigated in order for a company to upgrade its operations and become a PN Factory.

During the investigation to establish which these operational areas could be, it was very interesting for us to note, that over the years, VBM had already gone through the same process of upgrading its operations from a CKD Assembly Plant. It was now working as a PN Factory for its body parts, and seemed to have the necessary departments to do the same job for chassis. Taking this into consideration, we decided that the crucial operational areas already existed in VBM for this upward migration to happen. Hence it was clear, that the most important departments to examine were Product Development Engineering, Process Engineering, Beredning, Production, Purchasing, Traffic, Logistics, Warehouse, Finance and IT. Having this in mind, and with our understanding of the subject, we further approached a Volvo Director in VBM who reinforced our way of thinking, and who also pointed out the importance of these operational areas.

In order to learn about the current issue areas regarding the upgrade of the operations at VBM, the above-mentioned operational areas were studied. We were able to interview the person in charge of each of these ten as well as conduct three group interviews at the Warehouse, Purchasing and Traffic departments. It is important to take into consideration that VBM's Head of Materials department selected most of the contact persons. However, looking into the organisational structure of the companies involved in the research, the people interviewed were selected correctly and were the best-suited individuals to talk to for the purpose of this investigation.

All the interviews were conducted personally with the active participation of both of us with an option for a second interview to clarify issues that had been raised the first time. The interviews conducted ranged from one hour to four hours. The interviewed individuals were open and showed interest in the subject. The issues discussed in the interviews were related to the research conceptual model elaborated by us, and the questions established in the problem formulation. Most interviews were recorded, subject to the

interviewees' approval, and written notes were taken alternately by us during the whole process. During the whole interview process we felt that we did not influence the interviewees in any way as they were free to lead the discussion.

When required, we also had an opinion in choosing additional people for interviews when we thought that they could be of importance for a more profound analysis of the investigation. Not only Mexican workers were approached but Swedish workers at VBM also participated in the investigation. This had to be taken into consideration as well as the cultural background of the interviewees. This related especially to the Mexican culture of being somewhat careful in being too negative towards management wishes and directions.

2.2.2 Secondary Data Collection

On the other hand, we have also used secondary data for this case-study research. The data was collected from internal and external sources and gave us a basic stand point for the research. The secondary data helped us understand the external environment VBM was working in and provided us with good information for the first part of the empirical findings.

The internal sources for secondary data included our visit to Volvos library where we could obtain specific Volvo Bus related information from reports, magazines, brochures, and newspapers. We also entered Volvo Bus Corporation and Volvo Bus de Mexico's website to obtain general data about the companies. Furthermore, at VBM we were given access to the companies Intranet, for information gathering activities. The accessibility to VBM's internal reports and other relevant internal documents also provided us with a better overview of the situation.

External sources included information from the Economic library at the University and the Internet. By using these two sources, we were able to look at prior research on the subject and improve our knowledge. The articles we worked with were mainly obtained from economic websites.

2.3 Analysing the Case Study Findings

The analysis and interpretation of data for this report was an ongoing process, where we discussed our findings throughout the whole thesis, and made any necessary developments in accordance to the abductive approach we had chosen to work with as mentioned earlier.

2.3.1 Criteria for interpreting the findings

For a better understanding, and in order to be able to establish clear-cut conclusions, a table was developed where the most important issue areas were highlighted. These issue areas were identified after examining all the information gathered from all the interviews. We first sorted the raw facts in one document where we put the issues under low-level headings. Subsequently, these issues were put together into larger issue areas as deemed appropriate based on our own understanding and interpretation. By undertaking this classification process, we were able to come up with the main issue areas which were consequently placed in an Issue Table (Table 3 – Main Issues and Concerns at VBM).

By carrying out this procedure, the interpretation of the data and the connection of these issue areas with the competitive priorities were subsequently easier to bear in mind. The process to analyse the case study findings took into account all the data from all parties involved in the research thereby leading to a clear answer to the main problem as well as the formulation of recommendations.

Drawing from the theoretical tool used and the empirical data gathered, this thesis argues the existence of ten main issues that appear to be the most important to address when undertaking a strategic upward migration to a PN Factory. More specifically, these issues and concerns are Cost, Systems, Suppliers, Process, Bill of Material, Design Change Notifications, Human Resource needs and other issues in the form of Local Integration, Physical Space, and Scheduling and Prognosis. This thesis explores in more detail what the specific concerns under each issue are, how to resolve them and what the impact on competitive priorities will be.

2.3.2 *Relevance & Quality*

With the intention of reinforcing the validity of this thesis, data was gathered both in Sweden (HQ and VBB), and in Mexico (VBM). This helped us obtain different opinions from the two sides in a more efficient manner, and furthermore made the comparison and analysis easier to manage. This helped us to, in a better manner, find out the specific point of view of each party and thus evaluate how each one perceived the situation. Nonetheless, most of the interviewees agreed on most of the issue areas identified.

A total of 24 people in the management areas in HQ Sweden, VBB and in VBM were approached. In order to obtain detailed information regarding all the interviewees involved in this research project please refer to Appendix 11-6. The amount of information gathered from the interviews was manageable and easy to evaluate. All in-depth interviews were conducted in person with the presence of both of us. All primary data collection was documented shortly after the interview took place. Any differences were highlighted and further discussed between us. Additionally, secondary data was filed and all drafts of the report were saved. Of equal importance in this thesis has been our provision for validity in the research undertaken and the result presented. It is argued that there are three main types of validity, namely internal validity, face validity, and external validity.³⁴

Internal Validity refers to the specific study at hand and not to the generalisation of results.³⁵ For the purpose of this study the sample of management employees was chosen by VBM. They were aware of the importance of each area in the company and thus provided us with the best suited individuals to talk to.

Face Validity refers to the results from a specific survey that appears generally credible in the lack of supporting evidence.³⁶ In this study the face validity was evident and results in this sense very valid. During all personal interviews we experienced that the individuals were honest and answered in the best way they could to get the correct message through.

³⁴ Chisnall, 1997

³⁵ *ibid*

³⁶ *ibid*

External Validity refers to the degree in which the results could be generalised to other research situations. A threat to external validity is an explanation of how you might be wrong in making a generalisation.³⁷ In this study external validity would imply that the results gained from the interviews in the Swedish HQ, VBB and VBM could be used to generalise about what needs to be taken into consideration when upgrading the strategic role of a plant in other Volvo manufacturing plants. We believe that this type of generalisation can be drawn from the study conducted because the data collected has been made from a Volvo Assembly Plant.

Moreover, the conceptual model (Figure 6, p. 43) elaborated by us could be used in similar investigations, and the results of this report could be used as an initial stand point for other similar upward migration projects in other automobile manufacturing Assembly Plants.

At all times, the aim was to give as much reliability as possible to the data and information collected for this thesis. The analysis of this project was mostly carried out using the primary data collected by us for this specific purpose. This increases the reliability of results as data has not been collected for any other purpose and has not previously been analysed. Since interviews were able to be undertaken in Swedish, English, and Spanish, the interviewees were allowed to choose the language in which they thought they could best express themselves. This arguably also increases the validation of the interviews and the information gathered. In addition, some of the managers were interviewed twice to confirm observations and opinions from other interviewees further providing the reliability of the interview data.

³⁷ Chisnall, 1997

2.4 Critical Review

With additional time, resources, and assistance at hand, it would have been interesting to conduct an in depth multiple- case study. Had this been feasible, a more illustrative and in-depth analysis of a factory operating as a PN Factory for Chassis could have been made, in order to compare VBM Chassis activities and the way that this plant was operating. However, with the complexity and wide scope of the research area at hand, it was believed that a more detailed understanding of the research area could be given by concentrating on only one case. This investigation is therefore more interesting and of more valuable use for VBM as this company is currently working on a project investigating how to undertake a potential PN Factory upgrade.

The research based view of using a case study approach resulted as the best alternative for this investigation. However, the limited time that we had to undertake our research in Mexico City and collect the primary data at VBM's installations, should be taken into consideration. The process of a CKD Assembly Plant is very extensive and complex. There are many departments which are interlinked in the day-to-day procedures. For this reason, we believe that without the time limitation in the field study in Mexico, more data could have been collected under a longer period of time and more people could have been approached. The same time delimitation was perceived in the field study in Sweden. Since the interviewees were established late in the investigation, this had some implications for future research. A more profound understanding of the manufacturing process before making the trip to Mexico would have eased the general understanding of the subject and facilitated our workload.

Moreover, had we been able to select the interview participants ourselves, maybe a more objective outcome of the research area could have been obtained. As it was now, the people selected for the qualitative interviewing process was made by VBM. Nonetheless, we believe that due to our limited knowledge of the research topic at an initial stage of this thesis, VBM was best suited to do this selection. Had we been able to select the individuals, maybe not all the important people would have been approached. Additionally to all of this, it should be mentioned that prior knowledge of the research area could have helped us understand the situation we were working in better. None of us have worked in the automobile industry before, something which would have helped us at the beginning of the investigation.

3 Theoretical Framework

In this section we would like to specify the theories we used throughout the thesis. We will first describe why the manufacturing strategy theory is important in our work, how the work of other researchers such as Kasra Ferdow influenced our understanding of the subject and how the Resource Based View supported the investigation we made at the company. Finally, we will sum up our understanding of these theories in a conceptual model which will help us answer the questions formulated at the beginning of this thesis.

3.1 *Manufacturing Strategy*

Manufacturing strategy, or operations strategy as it is sometimes referred to, was arguably launched as a research area in the late 1960's. It was during this period that Skinner gave out his classic article, "*Manufacturing – Missing Link In Corporate Strategy*". In this article, Skinner pointed out that the strategy of manufacturing can have a major impact on the performance of the company and that the manufacturing strategy should support the business strategy in reaching the company objectives and achieving competitive advantage.³⁸

Most writers agree that there exists a hierarchy of strategic imperatives with corporate strategy driving business strategy, and this in turn driving functional strategies including manufacturing. The view of capabilities driving the strategic process requires a more proactive posture where internal strengths drive strategy and create markets. It has been argued that manufacturers should adopt approaches to manufacturing strategy which incorporate the parallel process of top-down, market driven reactive adjustment, and bottom-up capability building.³⁹ Skinner emphasised that factories' could be used as a strategic competitive weapon if manufacturing executives recognised the capabilities that a factory held. His proposed paradigm identified the ways in which production management could be analysed as strategic and tactical decision variables. More specifically, Skinner emphasised the five P's of production management as the centre of focus, namely People, Plants, Parts, Processes, Planning and Control Systems.⁴⁰

³⁸ Nilsson, 1995

³⁹ Tranfield & Smith, 1998

⁴⁰ Chase & Quilano, 1991

In addition to the focus on production management and capabilities, the notion of factory focus and manufacturing trade-offs was highlighted. The arguments were that a manufacturing factory could not, and should not, try to excel on all performance measures in terms of quality, cost, delivery, and flexibility, but should rather try to focus its activities and efforts to undertake capability prioritisation.⁴¹ Attempting to excel on all these competitive dimensions would mean that the manufacturing plant ran the risk of ending up second best on all of them.⁴²

However, since the initial development of Skinner's ideas on manufacturing strategy and the argument for focus and manufacturing capability trade-offs, the competitive environment has become more volatile and subject to change. Therefore, the notion of trade-offs has been criticised as limiting a manufacturing factory's vision about what is really possible in today's manufacturing environment.⁴³

Ferdow and De Meyer (1990) argue that the progress and development of each capability should never cease.⁴⁴ In a similar manner, Schroeder and Pesch (1994) have shown that this kind of trade-offs cannot be sustained for a long time, since as soon as a firm has mastered some focus, changes in the environment can reduce its relevance rapidly. They furthermore argue that the only way to keep operations strategy relevant under strong competition is to forget trade-offs.⁴⁵ Manufacturing management must now seek to balance the competitive priorities and seek to excel on all dimensions in order to become and stay competitive.

It is furthermore argued that the manufacturing strategy process governs the management of the competitive priorities. This process can be described as the procedure in which the manufacturing strategy is designed; developed and implemented.⁴⁶ This process is arguably governed by two different approaches in the literature, which furthermore are believed to be combinable. These two approaches are referred to as the market-based and the resource-based approach.

⁴¹ Chase & Quilano, 1991

⁴² Corbett & Claridge, 2002

⁴³ Chase & Quilano, 1991

⁴⁴ Corbett & Claridge, 2002

⁴⁵ Gagnon, 1999

⁴⁶ Rudberg, 1999

However, whereas the market-based view focuses on the link between marketing and manufacturing and sees manufacturing as focusing on following the rules dictated by the market, the resource-based view takes a more proactive approach. It argues that it is more profitable to focus on developing, protecting and leveraging a company's unique operational resources and advantages, than to let the market solely set the rules for manufacturing. By doing so, a manufacturing firm can change the rules of competition.⁴⁷

In addition to this, Dicken (2003) argues that it is possible to identify four stages in the development of a nation's automobile industry. His classification does not mean that all countries will pass through this sequence but it does provide a useful classification of the different types of automobile plants that currently exist in the world.⁴⁸ The stages proposed by him are: Import of Completely Built-Up (CBU) vehicles by local distributors, Assembly of Completely Knocked Down (CKD) vehicles, Assembly of CKD vehicles but with increasingly local content, and Full-scale manufacture of automobiles. Please refer to Appendix 11-7 for a more detailed description of these stages.

However, whereas the discussion and existing research on strategic manufacturing process, resources and capabilities, and manufacturing objectives has predominantly taken the whole industry or the whole subsidiary as the unit of analysis, Kasra Ferdow's model on the strategic role of manufacturing plants, takes the plant itself as the central unit of analysis. His work and model distinguishes plants on the basis of the level of competence in the plant and the location advantage, which is an element of the environment in which the plants operate. His focus is on the evolution of subsidiaries' role as they learn and acquire managerial and technological capacity.

Location advantages according to Ferdow are access to low cost production input factors, proximity to market, and use of local technological resources.⁴⁹ However, location advantages are arguably no longer enough to sustain competitive advantages as the changing global environment has made it easier for many companies to gain the same location access. Therefore, we believe that the second dimension presented in Ferdow's model can be used to better explain the way in which a foreign manufacturing plant can develop.

⁴⁷Rudberg, 1999

⁴⁸Dicken, 2003

⁴⁹Vereecke & Van Dierdonck, 2002

This second dimension is the plant's competence, simply defined as the extent to which certain competences and capabilities are present in the plant. The work of Kasra Ferdow is also of primary importance in this thesis due to its expression of the evolving nature of foreign factories. Ferdow advises that:

*“In order to increase manufacturing's strategic contribution, a company generally must upgrade the role of its foreign factories.”*⁵⁰

Ferdow, through his research, argues that although foreign plants often start out with low level of competence and a primary goal of taking advantage of low wages and production cost, it should not stay in this mode. These plants, he argues, will find it difficult to maintain their productivity over time, as few manufacturing managers will be capable of maintaining a high rate of productivity. Further to this, the low competence of a foreign plant is believed to contribute very little in the long run, to the corporation as a whole in terms of knowledge and might even mean that the corporation might be missing an opportunity to benefit from local expertise and market know-how.⁵¹

With this in mind, the desire to invest in a plants competence and development becomes evident. By investing, a plant is given the opportunity to fulfil a more substantial strategic role, furthermore allowing it to develop its internal capabilities and thereby facilitating its alignment to its environment. Failure to do so would put the plant in a vulnerable position and expose it to a situation were it may fall behind in terms of competitiveness and general development. In addition to this, there are benefits to be drawn on a greater level for the parent company, where the increased strategic role of a foreign manufacturing plant can help in developing corporate learning and increase knowledge.

Another interesting aspect of the evolvement of the strategic role of foreign manufacturing plants and Ferdow's model is its dynamic nature. Work of other researchers confirms that the plant's strategic role is a dynamic concept changing over time, and that evolution in the company's internal and external environment may accelerate such a change.⁵²

⁵⁰ Fleury, 1999

⁵¹ Vereecke & Van Dierdonck, 2002

⁵² ibid

Ferdow uses a simple model to conceptualise and discuss the distinct strategic roles of plants. In his work (Ferdow, 1997), he identifies six strategic roles that foreign factories can take, namely Offshore Factory, Server Factory, Source Factory, Contributor Factory, Outpost Factory, and Lead Factory. Interesting to note is also Ferdow's argument that even without an explicit top-down decision to develop local competence, some plants seem to follow a natural way upwards in the model.⁵³ Ferdow argues that the roles evolve from:

*“just supplying products”, over “being a focal point for the company”, to becoming “a plant that other plants depend upon”*⁵⁴

For a more detailed description of the different plant roles, please refer to Appendix 11-8.

From the research undertaken by Ferdow, we have been able to identify two additional competitive priorities that a manufacturing unit needs to focus on. It is our view that the previously mentioned competitive priorities are more related to the product itself, two additional priorities related more to the manufacturing unit needs to be discussed. This is in order to better understand how a company can put better focus on the earlier discussed manufacturing competitive priorities and how it can develop its strategic manufacturing role. These additional competitive priorities have furthermore been established through observations and discussion with people involved in the automobile manufacturing industry.⁵⁵ More specifically, these have been identified as Competence and Capability Development, and Independability. In combination with the competitive priorities identified through the work of Skinner, Ferdow and De Meyer (1990) and Schroeder and Pesch (1994), we believe that six competitive priorities can be established.

3.1.1 Competitive priorities

As discussed previously, the manufacturing strategy literature indicates that a firm's operational and manufacturing capabilities can have an impact on the firm's performance and its ability to successfully employ certain strategies.⁵⁶ The literature has also established four competitive priorities as important

⁵³ Vereecke & Van Dierdonck, 2002

⁵⁴ *ibid*

⁵⁵ Field Study in Sweden & Mexico

⁵⁶ Phene & Almeida, 2003

dimensions in which emphasise must be directed to. Although their definitions might vary slightly in the existent manufacturing strategy literature, the dimensions in question are typically referred to as Cost Efficiency, high Quality, fast and reliable Delivery, and product/process Flexibility.⁵⁷ In addition to this, we have identified an additional two competitive priorities that we feel are important to understand in the form of competence and Capability Development and Independability. These will be described more in detail below.

3.1.1.1 Cost Efficiency

Certain costs will incur in the process of manufacturing and selling vehicles. These costs can incur either directly as a part of manufacturing operations and indirectly in the processes of manufacturing and selling. The indirect costs may be production related, such as R&D and engineering; business-related, such as corporate staff salaries and pensions; or retail-sales related, such as dealer support and marketing.⁵⁸ Important to remember is that Cost Efficiency will impact on the competitiveness of a manufacturing firm both in the short and long-term and its development should be a continuous process. Competing in the marketplace on the basis of Cost Efficiency requires striving for low cost production. In order to keep manufacturing costs competitive, managers must address material, labour, overhead and other costs. Realising low inventory level, decreasing labour cost, and reducing machine time will all have a positive impact on Cost Efficiency.⁵⁹

3.1.1.2 Quality

Quality has been identified as a manufacturer's capability to compete in the world market as it means superior features and close tolerance of the product.⁶⁰ Though there is a wide variety of concepts surrounding the term "quality", many agree that quality is one of the important critical success factors for organisations to achieve competitiveness. This is a true statement for the manufacturing sector, and more specific for the automobile industry.⁶¹ To reach the quality goal, requires focus on quality in all aspects of the company's operations. Processes need to be implemented and undertaken correctly from

⁵⁷ Duray & Ward, 2000; Voss, 1995; Ling, 2000.

⁵⁸ Vyas, et. al. 2000

⁵⁹ Ling, 2000

⁶⁰ ibid

⁶¹ Khanna, et. al.

the beginning and defects and waste be eliminated from operations. In particular, ethics, integrity, trust, training, teamwork, leadership, recognition, and finally communication have been highlighted as important elements for a company to evaluate in order to implement and strive towards high quality.⁶² In addition to this, it is argued that more specifically for the automobile industry, there are seven more specific elements that can be identified in the form of leadership, strategic planning, information management, human resource focus, customer and market focus, supplier focus, and process management.⁶³

3.1.1.3 Delivery Capability

Delivery Capability is primarily a time issue, defined in a number of aspects of an organisations capability. One of these aspects is how quickly a product or service can be delivered to the manufacturer and another is how quickly a product or service is delivered to the manufacturer's customer. Of equal importance is the rate at which improvement in products and processes can be made. Delivery Capability involves a careful identification of the steps and time needed to deliver a product or service and involves the analysis of the trade-off between time and cost, and between time and quality.⁶⁴

The importance of effective management of the supply chain has gained recognition in many manufacturing firms as customers have become more demanding of suppliers. As the global reach of supply chains expand, more complex systems are needed to manage across different cultures, technical standards and regulatory requirements, and greater physical distances. When difficulties with delivery performance are present, problems tend to cascade quickly forward through the supply chain.⁶⁵

3.1.1.4 Flexibility

Flexibility refers, in principle, to handling and responding to changes efficiently, and manufacturing flexibility is about efficient handling of changes involving the manufacturing function.⁶⁶ To succeed in the future, companies need to know how to handle the increasing rate of change in their environment and how to manage and implement their operations. Improving forecasting

⁶² www.Sixsigma.com

⁶³ Khanna, et. al.

⁶⁴ Ling, 2000

⁶⁵ Milgate, 2001

capabilities or adding extra resources is only a viable solution to a minor extent, and the extra cost can not always be justified in most industries. A more attractive alternative is to considerably improve flexibility.⁶⁷

Flexibility can furthermore be defined in terms of increasing and/or decreasing of product mix, volume, and product design. This also implies that the production operating system must be flexible to handle specific customer needs and changes in design. Manufacturing flexibility is perhaps the most obvious response to external uncertainty, because of its accommodating nature.⁶⁸

3.1.1.5 Competence and Capability Development

The development of capabilities allows the manufacturing unit to build up its own resource base and competence. This is believed to be particularly relevant to industries dealing with products that are highly technical in design or method of manufacture. By developing its own capabilities, the unit can acquire the necessary core competences to compete successfully in the market place.⁶⁹ One example where the need for Capability Development is of outmost importance is technology. All value activities use technology even if it is only through usage know-how. Technology might be concerned directly with the product design, with process development, or with materials improvements.

By developing its capabilities so that new activities can be undertaken or old ones performed better, a manufacturing unit can better prepare itself, and be ready, to react to new challenges and opportunities coming its way. This is furthermore a competitive priority that needs to be under constant consideration in order to facilitate the growth and development of the whole company. If a company becomes complacent and does not seek to continuously develop its capabilities, it runs the risk of missing out on industry developments and forces, which its competitors might be better suited to take advantage of. By creating new, or developing current capabilities, a manufacturing unit can better focus on the manufacturing competitive priorities discussed above. The development of such capabilities is closely linked to the notion of independability.

⁶⁶ Nilsson, 1995

⁶⁷ Mattsson, 2000

⁶⁸ ibid

⁶⁹ Johnson & Scholes, 1999

3.1.1.6 Independability

The term Independability as used in this thesis relates to a manufacturing units connection to, or dependency of, another subsidiary in the corporate structure. This can relate to the delivery of input material, process activities, or output material and products and is furthermore related to the degree of control that a manufacturing unit has in making its own decisions. It is believed that the stronger this dependency on another unit is for the subsidiary in question, the more limited it will be in terms of making its own decisions. This will impact its ability to react to opportunities and threats, particularly in its immediate local environment.

At an early stage of its corporate life, a subsidiary might need to receive much assistance in its business and process activities from other corporate subsidiaries more capable of undertaking a particular activity. Further to this, it might need some assistance in the processing and development of some production material input and output handling. Nonetheless it should not remain with this strong dependency. It is our belief that this dependency needs to be reduced over time in order to develop the ability of the firm to better deal with market opportunities and to have a better control over the manufacturing competitive priorities discussed earlier. Hence we believe that the focus on competitive priorities can better be undertaken through a simultaneous focus on Competence and Capability Development and an increase in Independability. Our discussion does not entail that foreign manufacturing plants should not try to be part of a greater network of corporations. It simply implies an effort towards trying to rid itself of dependability which might hinder its ability to develop or enhance competencies and capabilities and increase its decision making authority over its own operations.

As argued previously, a focus on the company's internal resources and capabilities can help to understand what the factors impacted by the upward migration of the strategic role of a foreign manufacturing plant are. Although the external environment and its dynamism gives an understanding of this, the identification of internal resources and capabilities can help to better understand what leading role a manufacturing firm can have itself in increasing its competitive priorities in terms of Cost Efficiency, Quality, Flexibility, Deliver, Competence and Capability Development, and Independability.

3.2 Resource Based View

Applying a Resource Based View (RBV) to a manufacturing plant can help to identify unique and strategic competence and capabilities. It can also illustrate how these can evolve inside a firm and their relationship to the firm's competitive advantage.⁷⁰

The RBV, originally developed by Wernerfelt (1984), was an attempt to build a consistent foundation of the theory of business policy. The argument was that competence, resources, and capabilities in a company that are rare, valuable, without substitutes, and difficult to imitate could aid in achieving and sustaining competitive advantage by allowing a company to improve effectiveness, capitalise on opportunities and neutralise threats.⁷¹ Furthermore, this view maintains that competitive advantage can be achieved through a combination of unique resources and capabilities classified into mainly three principal types, i.e., tangible, intangible and human.⁷²

It is also argued that the achievement of competitiveness in the globalised new economy depends on a firm's capacity to develop and deploy its knowledge-based resources. Nonetheless, not all competencies, resources, and capabilities are equally important in a specific situation. This depends on the specific character of the threat, opportunity, or influence faced.⁷³

As argued earlier, previous research in the field of manufacturing strategy has used the notion of competitive priorities, competence and capabilities in reference to a company's ability to meet the needs of the market in terms of low cost, high quality, high flexibility, and delivery reliability.⁷⁴

The use of the RBV in manufacturing strategy research stems from its ability to provide a new perspective and strong theoretical foundation for analysing the strategic impact of investments in manufacturing processes. Manufacturing strategy is believed to be particularly open to the RBV approach for two main reasons. First, manufacturing resources and competencies can create manufacturing capabilities that are difficult to imitate. Secondly, superior

⁷⁰ Coates & McDermott, 2002

⁷¹ Rodriguez Perez & Ordoñez de Pablos, 2003

⁷² Phene & Almeida, 2003

⁷³ Rodriguez Perez & Ordoñez de Pablos, 2003

⁷⁴ Schroeder, et. al.

competencies and capabilities in manufacturing processes have been demonstrated to give performance advantages, and consistent improvement of manufacturing processes can lead to a series of competitive advantages.⁷⁵

Several approaches for developing manufacturing capabilities have been articulated. These state that manufacturing capabilities and their development should play an important role in competition and be subject to sequential improvement initiatives.⁷⁶ The RBV approach can be used in defining competencies, resources, and capabilities that have the potential of creating a competitive advantage for a manufacturing plant. Hence it can also be used to identify issues and limitations that exist in these.

Resources and capabilities have varying definitions and interpretations in the RBV literature, where some researchers do not make a distinction between resources and capabilities, while others do. Resources are sometimes defined as strategic assets, such as trade secrets or specialised production facilities, whereas capability is defined as the “*ability to integrate, build, and reconfigure internal and external competencies*”.⁷⁷ It is commonly agreed upon that capabilities are more likely to result in sustained competitive advantage, and sometimes the bundling of resources is referred to as capabilities.⁷⁸

The RBV approach can assist us in this thesis by helping to investigate the resources, competencies, and capabilities of the case research company, when upgrading its operations to PN Factory status. However, one of the limitations with the RBV approach is the difficult process of reaching a consensus on what should stipulate a strategic resource, competence or capability within a firm. This is something that should not be underestimated as it can severely impact the RBV process and its success.⁷⁹ According to Fine and Hax (1985) there are ten management levers that can aid in achieving a change in manufacturing strategy. These ten levers have been established as facilities, capacity planning, quality management, vertical integration, supply chain relationships, new product development, process and technology, human resources, inventory management, and production planning and scheduling.⁸⁰

⁷⁵ Schroeder, et. al.

⁷⁶ *ibid*

⁷⁷ *ibid*

⁷⁸ *ibid*

⁷⁹ Gagnon, 1999

⁸⁰ Pyke, 2000

However, whereas their work was primarily concerned with the development of a green field factory in a non-specific industry, it is our belief that the levers or operational areas identified earlier in this thesis can be used. This is because they are more automobile manufacturing plant specific and identified in the case research company. The RBV approach will hence be used to investigate the operational areas of the case company mentioned earlier, namely Product Development Engineering Department (PDED), Process Engineering Department (PED), Beredning, Production, Purchasing, Traffic, Logistics, Warehouse, Finance, and IT.

3.3 Conceptual Research Model

After the theories have been presented and discussed, they will need to be presented in a way that reflects our own understanding and ideas. This includes the way we see the linkage between the two main theories chosen in this thesis and how we believe that they can complement each other. To support our understanding and knowledge, a conceptual research model has been created to help with an illustration. This will be described in more detail below.

One of the tasks of HQ is to be responsible for setting the direction for the rest of the corporation by establishing a business strategy. This business strategy will in many way impact on the development, support, and general goals and aims of all its foreign manufacturing plants. This is because the corporate business strategy should support the strategy of foreign manufacturing plants at the same time as they should support the corporate business strategy.

Moreover, and as argued in the theory, the development of foreign factories can be a top-down decision as well as being the result of internal pressures and desires coming from the plant management itself. Hence the operational functions of a factory and the overall business strategy of a company are interlinked in that they can both influence and support each other in one way or another. As a result, it can be argued that the relation between HQ and the foreign plant is one where the HQ can both push for and resist the increase in strategic importance of a foreign plant. In the same manner, this push and resistance can exist in the foreign plants relationship with the HQ.

It has become clear from the manufacturing strategy literature that resources and capabilities that a manufacturing plant has can, and need, to be used to sustain this end. The RBV and the work of Ferdow argues that it is the competence, resources and capabilities that a foreign firm holds that can aid, and that should assist in the increase or development of the strategic role of a foreign plant. On a micro-level the development of resources and capabilities can be a result of factory management efforts as well as a result of internal learning and development that might come from the resources and capabilities themselves. No matter what, it is our belief that manufacturing plant development is a natural step for foreign manufacturing factories.

The establishment of four key objectives of manufacturing strategy, namely Cost Efficiency, Quality, Delivery, and Flexibility, are depending on the resources, capabilities and operational function of a foreign factory. However, at the same time, these four objectives are dependent on the degree to which the necessary capabilities are present in a foreign factory or the extent, speed and ease they can be developed. This is of major importance in order to create and sustain competitive advantage as well as responding to new opportunities and threats.

We are also of the understanding that a potential upward migration to a PN Factory will not only have an effect on the four competitive priorities established by the manufacturing strategy literature. Taken the work of Ferdow into consideration, it is our understanding that for a plant to stay competitive, and to have the potential to develop itself there needs to be a constant strive towards the development of new competencies and capabilities. At the same time, a foreign manufacturing plant will need to try and rid itself from the dependability it might have on HQ related functions and operations that are an obstacle to its development of new competences and capabilities.

Since the corporate HQ generally possesses the highest level of knowledge or retains some key functions locally, many manufacturing plants are dependent on support from them in order to undertake their manufacturing operations. Especially, it is believed that the support of the corporate HQ is required, or at least desired, to facilitate the easiness of knowledge transfer of new functions or the development of factory competence, resources, and capabilities.

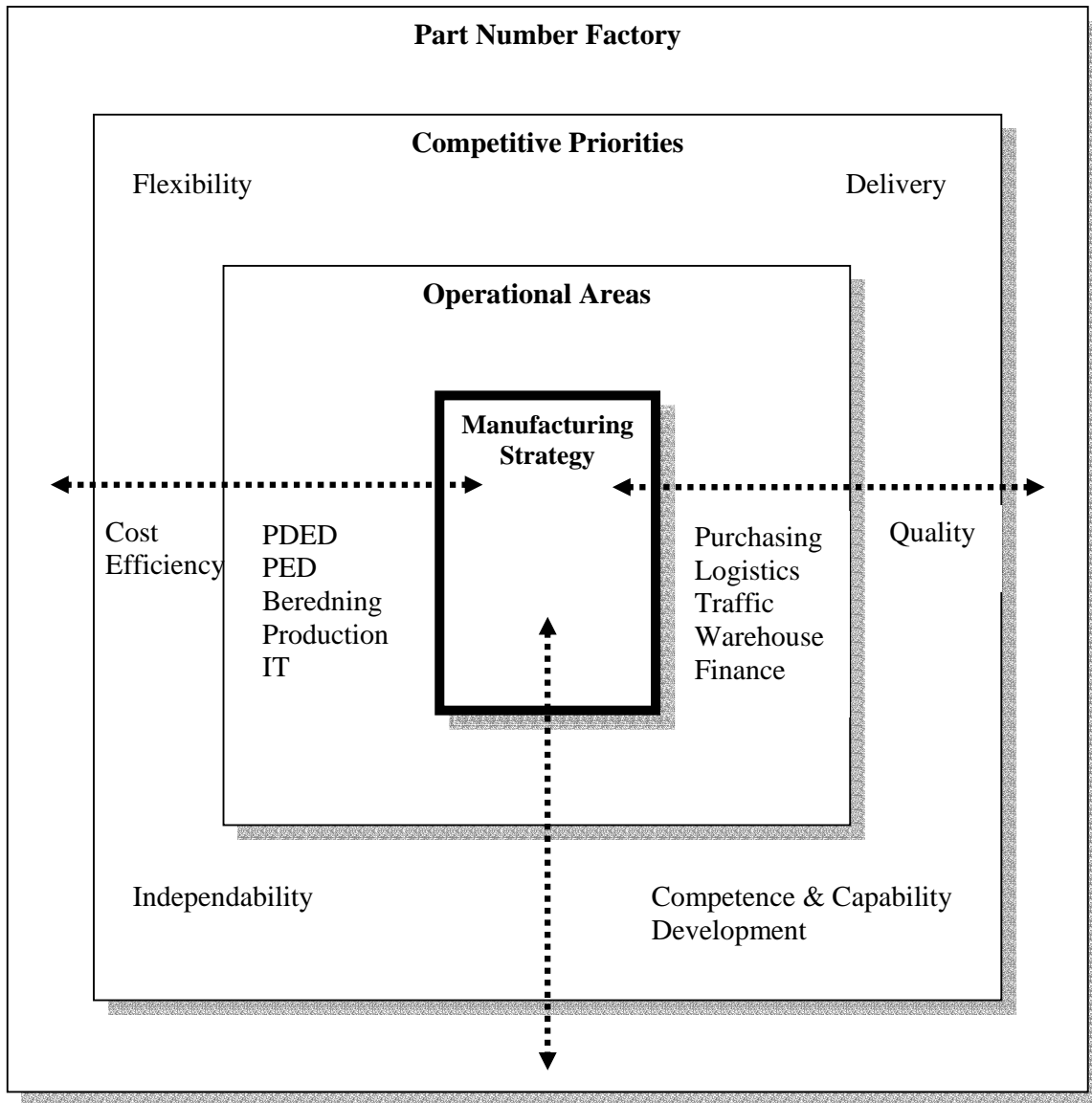
Nonetheless, it is our understanding that the dependency on HQ functions can at the same time be an obstacle to the development of a foreign manufacturing plants competence, resources, and capabilities. This is because a situation might arise where valuable knowledge is not being transferred, hence increasing the dependability on support from HQ. Therefore, it is our belief that the development of new competencies and capabilities, as well as a gradual reduction in the dependability on HQ functions, is important for the development of a manufacturing plant.

In combination with a focus on price, quality, flexibility, and delivery, these will have an impact on the overall competitive priorities identified in the manufacturing strategy and at the same time will act as competitive factors that can be used to react faster to market demands.

This thesis will therefore concentrate on the connection between the six competitive priorities identified and the impact the potential upward migration to a PN Factory would have on these. More specifically, it is our belief that the upward migration to a PN Factory and its potential impact on the plant itself can be understood by having a closer look at the issues and concerns that might arise in its operational areas. By this, it will also be possible to establish whether they will have a positive or negative impact on the competitive priorities identified.

This will be done by taking a RBV approach to the investigation, looking closer at the current status of the operational areas at VBM, and thereby establishing the readiness level of VBM to take this potential upward migration to become a PN Factory. Our elaborated model will be applied to the empirical data collection process that follows and thus help in the future analysis, conclusion and recommendation section of this report.

Figure 6 Conceptual Research Model



Source: Authors' own elaboration, 2003

Part II – Empirical Findings

4 Mexico and the Automotive Industry

Before going into the empirical findings related to the case company VBM, it is in our interest to present a general background to the global and local environment in which VBM is operating. This is to provide a better understanding of the factors and events that might influence the decision to undertake the upward strategic migration of a CKD Chassis Assembly Plant to a PN Factory. This section will primarily focus on the global and local automobile industry and finally conclude with the bus transport sector.

4.1 Mexico

Mexico's geographic location, on a central point between North and South America, makes it a strategically important export market. Indeed, Mexico is the seventh largest export market in the world and the most important in Latin America.⁸¹

Due to Mexico's proximity to the United States and its political and economical environment, it has been seen to be a good country for short-, medium, and long-term investments.⁸² Since NAFTA membership in 1994, considerable growth in Mexican vehicle exports has been realised, making Mexico one of the leading countries obtaining Foreign Direct Investment (FDI).⁸³ Mexican direct investment in the United States reached \$4.2 billion, with almost \$1 billion being invested in year 2000 alone.⁸⁴ In addition, Mexico's automobile sector is a major recipient of European FDI, making it Mexico's most important sector in terms of EU capital investment.⁸⁵

Thanks to the countries' geographic location and network of Free Trade Agreements (FTAs'), it is able to offer a strategic hub from which to export both finished vehicles and auto-parts to major markets in North and South America, the EU, EFTA and beyond. The dynamic domestic market not only

⁸¹ United Nations, 2000

⁸² Bancomex, 2003

⁸³ United Nations, 2000

⁸⁴ *ibid*

⁸⁵ Bancomex, 2003

provides strong demand for vehicles and auto-parts, it also possesses a highly-skilled and efficient workforce offering access to world-class inputs and technology.⁸⁶

Since joining NAFTA, the import and export pattern of Mexico has changed dramatically due to changes in import and export regulations and the reduction of tariffs. While tariffs on light commercial vehicles imported into Mexico from the United States and Canada have been eliminated, heavy trucks and buses traded within NAFTA will remain subject to a tariff of 8 percent until 2004. The abolishment of tariffs on imported vehicles into Mexico has led to an increase in the number of vehicles imported by inside and outside located manufacturers.⁸⁷ The Mexican FTAs' has also had an impact on the tariff elimination schedule for auto-parts. Compared with the European Union, by the year 2007, tariff should be substantially reduced to 1.4.⁸⁸ The tariff elimination schedule can be seen below:

Table 1 Tariff elimination schedule for auto-parts 2000 - 2007

	2000	2001	2002	2003	2004	2005	2006	2007
Mexico	11.8	11.3	8.5	7.7	5.9	4.4	2.8	1.4
EU	2.7	1.3	0.8	0.4	0.0	0.0	0.0	0.0

Adapted from Source: Bancomex, 2003

The tariff elimination schedule fixed under this agreement is one of the most ambitious ever negotiated by either party. For the automobile and auto-parts sector this meant that by 2003, all Mexican exports of industrial goods (including vehicles and parts) to Europe would be free of duty.

The elimination of duties on European imports into Mexico will be introduced progressively, with full liberalisation scheduled for 2007. Rules of origin will progressively increase the regional content up to a maximum of 60 percent in 2006, as illustrated below.⁸⁹

⁸⁶ Bancomex, 2003

⁸⁷ World Market Research Centre, 2003

⁸⁸ Bancomex, 2003

⁸⁹ *ibid*

Table 2 Rules of origin (percent of regional content)

2000	2001	2002	2003	2004	2005	2006
50 %	50 %	50 %	50 %	50 %	50 %	60 %

Adapted from Source: Bancomex, 2003

Furthermore, trade with NAFTA countries has nearly doubled since 1994 but Mexico is pursuing additional trade agreements with Latin American countries and with the EU in order to lessen its dependence on the United States.⁹⁰ Currently about 75 percent of Mexican vehicle production is shipped to foreign markets, and nearly all of it goes to the United States.⁹¹ To the present, Mexico's extended network of FTAs provide access to more than 800 million consumers in 28 countries, accounting for 57 percent of the world's GDP.⁹²

Finally, we would like to indicate Mexico's principal industrial centres. These can be classified in three main cities, namely: Mexico City metropolitan area (which includes the Federal District), Monterrey, and Guadalajara. Although all have important participation levels, Mexico City stands out. For example, in the early 1990's the capital alone accounted for about half of the manufacturing activity, half of manufacturing employment and about one-third of all manufacturing firms in the country. This is due to the fact that the capital city comprises several characteristics. For example, you would find skilled workforce, a large consumer market, low distribution costs and proximity to government decision makers and the nation's communication system.⁹³

4.2 Global & Mexican Automobile Industry

The automobile industry is one of the most global manufacturing industries existent today. Its exposure to globalisation forces has furthermore led to acceleration of its reorganisation so that today the industry exists of a few major players.⁹⁴ These giant players can arguably be said to be operating in an assembly industry in which many have established manufacturing and foreign assembly operations in many different countries. These are mostly concentrating their automobile production in the global triad (Japan, United

⁹⁰ Poillon, 2000

⁹¹ WARD'S Autoworld, 2001

⁹² *ibid*

⁹³ www.allRefer.com

States and Western Europe), although some Latin American countries such as Brazil and Mexico have an increasing importance.⁹⁵

Nearly all developing economies with an automobile industry operate both local content requirements and various types of tariff and non-tariff import restrictions. This has had an enormous impact on the structure of the industry as a general shift of policy towards export promotion has been noticed for quite some time.⁹⁶

The significance of the automobile industry is also expected to grow over the next decades. One reason for this is that it is estimated that within five years, half of the world's population will live in cities, and by 2030 the urban population will reach 4.9 billion, almost 60 percent of the world's total population. It is furthermore expected that the majority of the population growth will take place in developing countries. This is important as the growing demand for transport and energy in developing countries is tightly connected to the growth in population.⁹⁷

Mexico was the first country to highlight Latin America's growth potential. Even before the NAFTA agreement the country had established itself as a cost-effective export base.⁹⁸ In 2002, it was stated that the market could even pass Brazil.⁹⁹ Today, most of the major players in the automobile and auto-parts industries are present in the Mexican market namely: Volkswagen, Renault, Honda, General Motors, Daimler Chrysler, Mercedes Benz, Ford, BMW, Volvo, Scania, and Nissan. This can explain why Mexico today is the world's 9th largest exporter of vehicles and hosts a majority of international automobile manufacturers and suppliers.¹⁰⁰

In Mexico, the largest commercial vehicle producer is Diesel Autobuses SA de CV (Dina), which has been privatised since the early nineties. You can find companies manufacturing chassis, complete vehicles including integrals and bodywork in the country.¹⁰¹ Furthermore, Mexico's automobile market is

⁹⁴ Shimokawa

⁹⁵ Dicken, 2003

⁹⁶ *ibid*

⁹⁷ International Energy Agency (IEA)

⁹⁸ Andrew, 1999

⁹⁹ Jack & Gibbins, 2002

¹⁰⁰ Bancomex, 2003

¹⁰¹ Jack, 2000

outward oriented, with approximately 75 percent of national vehicle production destined for export. This gives an indication of Mexico's importance as a global manufacturing hub.¹⁰² Please refer to Appendix 11-11 and 11-12 for a more detailed description of the bus and coach production and sales and the forecast for bus and coaches.

Due to the liberalisation of the Mexican economy, economic growth has been visible in many key sectors. This can be perceived in the automobile and auto-parts sector, which has grown rapidly, developing into an important industrial cluster with state-of-the-art operations.¹⁰³ Furthermore, the automobile industry has been the largest destination for manufacturing FDI in Mexico, and is considered to be one of Mexico's most productive sectors.¹⁰⁴ It accounts for 16 percent of manufacturing GDP, 22 percent of manufacturing exports and 18 percent of manufacturing labour force.¹⁰⁵ The implementation of the NAFTA Agreement has led to a wider variety of imported commercial vehicles available in the Mexican market. This has moreover increased competition for manufacturers producing in Mexico changing the general pattern in the domestic market. With a higher level of competition in the domestic automobile market, consumers have a wider selection of imported vehicles. The undergoing expansion in the sector for vehicles and the availability of different vehicle models and types depends currently on the different tastes of the expanding middle and upper classes and the rise in consumer spending.¹⁰⁶

The scale of commercial vehicle production in Mexico was the sixth highest in the world in 2001, after the US, Japan, Canada, China and Spain. Production of commercial vehicles in Mexico represents approximately 1.6 percent of the Mexico's total employment in manufacturing, and accounts for roughly 3.7 percent of the country's manufactured exports.¹⁰⁷ Moreover, the auto-parts sector is also an essential part in the Mexican automobile industry. Total sales of auto parts and components have increased rapidly in recent years, more than doubling between 1996 and 2001.¹⁰⁸ Mexico's production of vehicles and the forecasts of production as well as the actual and forecast sales for bus and coaches can be found in Appendix 11-9 and 11-10.

¹⁰² Bancomex, 2003

¹⁰³ *ibid*

¹⁰⁴ United Nations, 2000

¹⁰⁵ Bancomex, 2003

¹⁰⁶ World Market Research Centre, 2003

¹⁰⁷ *ibid*

¹⁰⁸ Bancomex, 2003

The automobile components industry consists of a highly complex mix of firms with different sizes, types, and geographical context. These are producing an enormous variety of products, from the very simple to the extremely complex. It is estimated that purchasing of components account for between 50 and 70 percent of the cost of an average vehicle. The structure of the components industry is believed to be determined by the strategies of the automobile assemblers as well as some of the more powerful components producers themselves which arguably has the power to partly influence the strategies of the auto assemblers.¹⁰⁹

The Mexican vehicle components industry is also operated by roughly 820 companies, operating over 1,500 plants, including the Maquiladoras. A recent trend within vehicle manufactures is the moving towards JIT delivery systems and the upgrading of their products. This has led to a situation where auto-parts manufacturers in Mexico are finding it difficult to compete with imported components.¹¹⁰

In a sense, economies of scale importance and JIT have had to give way to the importance of the supplier relationship to achieve these things in the first place. More responsibility has shifted to the components suppliers who nowadays are responsible for “modular manufacturing”, meaning that they manufacture “sub assembly” and “module” units rather than individual components.¹¹¹ This change has come about due to changes in the technology of automobile manufacturing, both in product and process technologies.¹¹²

At the same time, the manufacturing chain has been decentralised due to the globalisation process and parts are now received all over the world as competitiveness across the markets has increased. Managing the supply chain in automobile firms will be decisive in order for companies to deal with changes in the fast evolving environment.¹¹³ About 3-4 million workers are employed directly in the manufacture of automobiles throughout the world and further 9-10 million in the manufacture of materials and components.¹¹⁴

¹⁰⁹ GPN Working Paper7, 2003

¹¹⁰ World Market Research Centre, 2003

¹¹¹ United Nations, 2000

¹¹² GPN Working Paper 7, 2003

¹¹³ Brizzi & Ahmed

¹¹⁴ Dicken, 2003

4.3 Global & Mexican Bus Transport Sector

The growth in vehicle production during the 1990's has been extraordinary. The bus, derived from the Latin word "Omnibus" is stated to be the most widely used form of public transport.¹¹⁵ Nonetheless, in many countries, the bus is still not fully recognised as the best alternative to get around, this being reinforced by the higher demand for private cars. Governments are getting involved in trying to reduce the increased purchase of private cars as this leads to increased congestion and pollution problems.¹¹⁶

Additionally, the world market for heavy buses shows considerable regional variations. In Europe, sales volumes shrank with more than 15 percent in 2002, with a particular large downturn in Germany, France, and Spain. The Nordic region grew while the UK remained at a low. In addition to this, the tourist coach market in the USA suffered a significant downturn. South America remained at a low while Asia showed encouraging growth.

A big concern in the transport sector in Mexico is the increased automobile ownership and travel demand. This cannot keep pace with the improvement of infrastructure and increase in supply. There is a big congestion problem in the country and a lack of efficient administration in the industry.¹¹⁷

Around 130,000 buses and coaches are in circulation in Mexico with some coaches built to high luxury standards. In Mexico it is clear that buses are needed for transport because of its rapidly expanding cities, as well as coaches for long distance services.¹¹⁸ Due to congestion and pollution problems, particularly in Mexico City, there seems to be a good demand for full size heavy duty city buses.¹¹⁹

¹¹⁵ Jack, 2000

¹¹⁶ Jack & Gibbins, 2002

¹¹⁷ International Energy Agency (IEA)

¹¹⁸ Jack & Gibbins, 2002

¹¹⁹ Jack, 2000

The development of transport infrastructure in Mexico City has been very uneven. It started off with the trolley line, then the bus system took over and since 1968 the metro system has operated. By 1985, 10,000 buses operated in the Federal District, and Mexico City functioned like other large Latin American cities. Soon however, growth in automobile traffic and the expansion of the metro put great tension on the bus system. In response to a declining return on investments in the system, the number of buses was reduced.¹²⁰

Soon after, various kinds of minibuses, called “colectivos” or collective taxis were introduced by the government as a way to privatise public transport and reduce government expenditures. However, this has led to a rise in personal vehicle, taxi and “colectivo” use, reducing the regional bus fleet from 15,000 to only 2,500. Moreover, the colectivos which were barely used today account for over half of the trips made.¹²¹

¹²⁰ International Energy Agency (IEA)

¹²¹ *ibid*

5 Empirical Findings Volvo Bus de México

Following the general perspective of the industry and country in which VBM operates, we can now go deeper into the subject and main purpose of this Thesis. We will start our investigation describing the ten operational areas deemed to be important in the upgrade process of VBM to become a PN Factory. Soon after, using our conceptual model, we will describe the main issue areas identified in each department.

5.1 Volvo Bus de México Operational Areas

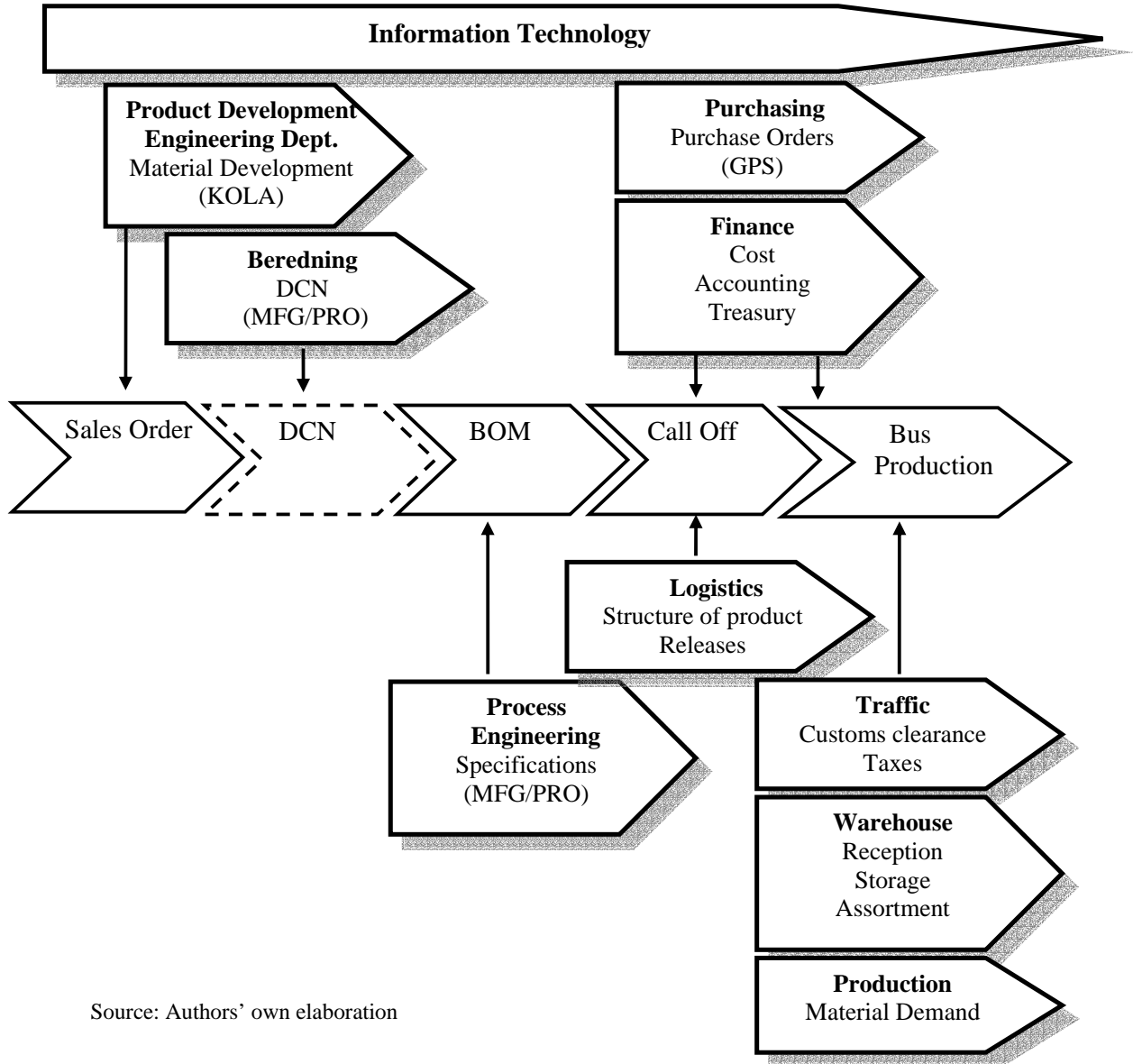
As discussed earlier in section 1.3 of this thesis, we have identified ten operational areas as important in an automobile manufacturing plant. The further investigation of these areas will be essential when looking at the upgrade migration of VBM to a chassis PN Factory. These departments have a specific role to play in VBM, from the delivery of the material to the assembly process itself. In addition to this, we believe that after having investigated the situation at VBB, HQ Sweden and VBM, the thorough study of these ten departments will reinforce and help us answer the main problem of this investigation and provide us with a better understanding of the proposed upgrade of VBM's operations. The industrial production system of VBM is made up of three different areas, or systems. These three are furthermore made up of different responsibilities and business processes and can be described as:

- Sales to Order system
- Order to Delivery system
- Delivery to Repurchase system

The Sales to Order industrial system is concerned with activities relating to the actual sales process, leading up to an order being placed. The Order to Delivery system is concerned with the process taking place between the placing of the Order and the production of the bus until ready for delivery. The Delivery to Repurchase is mainly concerned with processes related to the after market service of the bus once it has been delivered. All three business systems are crucial in the production of a bus, but for this thesis, the emphasis will be on the Order to Delivery industrial system as we believe that this area will be mostly impacted if becoming a PN Factory for Chassis.

The figure below provides an illustration of this Order to Delivery process:

Figure 7 Order to Delivery System



Source: Authors' own elaboration

The following section will now briefly describe the participation and process of each of these ten operational departments indicated in the figure above, with the intention of providing a better understanding of the daily work at VBM. This brief presentation will also lead the reader to the main problems surrounding the proposed CKD Chassis Assembly Plant upgrade.

5.1.1 Product Development Engineering

The Product Development Engineering Department (PDED) is in charge of the product and the product costs as well as internal and service area quality issues. This department is also responsible for Product Modifications (PM). PDED is also responsible for the customer adaptations and for answering the commercial area when they need consultation or when they have requirements for PM's or customer adaptations. This is referred to as Factory Consultation where the cost for engineering hours, changes in the product, and the lead time to do the job is established. In addition to this, this department also has workshops where they undertake test such as field tests and a lot of buildings of prototypes. PDED also have a support section in charge of the administration of the global KOLA system, the product structures in the system and the follow up of time reports. This department is divided into four groups, namely Body Parts, Exterior and Interior for Body, Body systems, and a small section for Chassis.¹²²

The PDED work process starts with the Order Form coming from the Sales Department. Its responsibility is to keep the Order Form updated with the available bus variants that a customer can chose from. These will be used by Sales to agree with the customer as to what variants can be produced, register the details on the order, and return it to the PDED. However, if a customer wants something in the bus specification outside the current variants available, Sales need to ask PDED for a customer adaptation. The Sales Order form filled in becomes the specification and this is the Work Order for customer adaptation. Once the Factory Consultation process is completed and the Sales department is informed of the possibilities of doing the customer adaptations, they will need to agree to this with the customer. Upon agreement with the customer, an order is created that goes to the Order Handling Team.¹²³

5.1.2 Process Engineering

The Process Engineering Department (PED) is the department that arguably is responsible for the creation of the Bill of Material (BOM), or the bus structure. In addition to this, it is their responsibility to verify that the production line implementation of new part numbers is done correctly. The department provides vital support to Production, Warehouse, Logistics, Purchasing,

¹²² Kjell-Arne Lindvall, Head of Product Development, 2003

¹²³ *ibid*

Beredning, and Finance. The main responsibility of this department is to feed all the necessary information regarding the BOM into the Material Requirement Planning System (MRP), which is part of the local factory system MFG/PRO.¹²⁴

The main supplier of information for PED is the Product Development Engineering Department (PDED), which is responsible for updating the KOLA system. This information is then taken from the system and put in the MRP as the Bus structure information. This is the information that all departments within VBM will more or less use in their activities. Once the right bus structure has been put in the system, they will inform the Production, Warehouse, Logistics, Purchasing, Beredning, and Finance departments that the BOM is complete.

At the moment the creation of the bus structure is undertaken manually, however, they are currently in the process of using a BOM Creator, which will be an automated process. Any gaps or missing information will be added manually. This would mean that the department would become more administrative but more specific in their job duties. The creation of an accurate BOM is a very complex issue that starts in the commercial area and with customer adaptations. Ideally there should be no customer adaptations but in a manufacturing plant like VBM it is practically impossible as there are always last minute changes because the client wants them. For the body, the information is sent to Sweden by Engineering in Mexico, who processes it and sends it back to Process Engineering in Mexico. For Chassis Process Engineering is currently receiving a “black box”. Engineering is not doing any work on the chassis as all changes are made in Sweden.¹²⁵

5.1.3 Beredning

The role of the Beredning Department is to implement all product and structure changes coming from the Product Development Engineering Department (PDED). Their role is to coordinate the work from all the departments that are going to be implicated by the process of a change to the product specification, and to ensure that these changes are implemented correctly. Due to its role, the Beredning Department is very important in a factory as all changes made to a

¹²⁴ Hector Nuñez, Head of Process Engineering, 2003

¹²⁵ *ibid*

Bus can be crucial for its final results. It is very highly involved in the Design Change Notification (DCN) process and responsible for the implementation of these. For body, the DCN is initiated from PDED at VBM whereas for chassis it is the Engineering Department in Sweden that is responsible.

The DCN process starts with PDED approving a change. The information of the proposed change is put in the KOLA system and also sent to the Process Engineering Department (PED), Beredning and the Quality department. PED will complete the data in the system through the interface between the KOLA system and the local MFG/PRO system. Beredning will then use the BOM produced by PED in MFG/PRO (drawn from KOLA through an interface) in order to start with the analysis of the information. The results of the analysis are added to the Implementation Analysis Document, which can be described as a technical paper made in Excel containing all the analysis details.¹²⁶

The Implementation Analysis Document is sent by e-mail to the Purchasing, Logistics, Process Engineering and Production Control departments, where the responsibility is assigned to one person. The role of the departments that receives the DCN analysis information is to evaluate by when they would be ready to implement it. After these departments obtain the e-mail sent by Beredning, a committee for the DCN implementation is set up.

Once Beredning receives an answer from all the departments as to when they think that they could be ready for the DCN implementation, it needs to establish the breaking point to introduce each DCN. Once this has been established, Beredning then sends the complete DCN information to all parties concerned; including at what unit the introduction should start and will furthermore co-ordinate the changes in the working units. The process for changes in chassis would mean that Sweden sends the documents with the changes to the Engineering Product Development department in VBM and then the process would be the same as with the body changes. It is more a global procedure to make changes for the chassis as it usually affect other plants as well.¹²⁷

¹²⁶ Ignacio Aguirre, Head of Beredning, 2003

¹²⁷ *ibid*

5.1.4 Production

Production is responsible for the production and assembly of material and components that make up the buses. This operational area is the biggest in VBM with approximately 1200 employees. The production area includes in-house production of material that will be used in the Body building process as well as a lot of frame welding. This area is also responsible for the assembly of the CKD Kits coming from VBB.

The production line is responsible for assembling the chassis and testing it before it goes to body building. The chassis assembly process takes roughly one and a half week to complete. In addition to this, 3 days of production is always kept in stock in terms of chassis. This is because it takes less time to assemble a chassis than creating the body. Altogether the production of a bus takes an estimated 20 days. This is because the chassis and body process are started at the same time and later on in the production process “merged” together.

The production process is a very important and costly area of VBM. It is estimated that it costs around 25,000 USD per day to stop the production line, in terms of wages, penalties, and other delays. Hence this area is very dependent on the right material being delivered at the right time and at the right place in order to undertake its activities.

5.1.5 Purchasing

Volvo Bus Corporation’s Purchasing Organisation is made up of a Global Purchasing department located in Gothenburg, Sweden and local Purchasing departments at the factories around the globe. The purchasing responsibility for Chassis Part Numbers lies in Sweden and VBB only. However, the Purchasing department in VBM plays a substantial role and consists of four sub-departments:

1. Buyers – who place the Purchase Orders in the GPS in the form of a Blank Order or a Contract Order, in addition to a Sample Order.
2. Administration - responsible for co-ordination and for ensuring that the information in the GPS and MFG/PRO is mirrored.

3. Supplier Quality Assurance - responsible for assuring that the material ordered meet the quality standards set by VBM. They need to assure that the material is according to the drawings of the engineers and if this is not the case, they need to handle the difference with the engineers or the suppliers.
4. Spare Parts - where the buyer is responsible to buy and decide about all spare parts. This department is divided into two, for the production warehouse and for the spare parts warehouse. The users of these two warehouses are different.¹²⁸

Each specific Part Number in the Volvo Global Purchasing System (GPS) is assigned to one individual, called a host. This individual is the main contact for dealing with the supplier in terms of negotiating the terms of the purchasing contract. The responsible host buyer is stated in the GPS. The purchasing organisations are built so that the local purchaser should put an order into the system and the global buyer collect the total volume of these orders in order to negotiate better deals in terms of prices and delivery terms with the supplier.¹²⁹ In brief terms, the Purchasing department works with three different types of Purchase Orders. These are the Blank Order, the Stand Alone Purchase Order, and the Contract Order.¹³⁰

If the Purchasing department needs to purchase a new part not existing in GPS, Purchasing needs to start looking for new suppliers to deliver this part, either locally or globally. There are two alternatives to buy the material. It can be bought either by using existing suppliers, which is recommended, or by developing new ones. A new part can also have two characteristics. It can either be a new part only for VBM or a new part for VBM and a standard part in the Volvo Group.¹³¹

5.1.6 Logistics

The Logistics department is composed of eleven people and three trainees. This includes one planner responsible for missing parts, and ten planners responsible for asking all the material needed. This department is responsible for making the Call Offs.

¹²⁸ Roberto Almaguer, Global Buyer, 2003

¹²⁹ Mats Lindevall, Global Buyer, 2003

¹³⁰ Roberto Almaguer, Global Buyer, 2003

¹³¹ *ibid*

The Logistics department will start their work after the Purchasing department has put the information regarding the Purchase Order and suppliers in the GPS. They will receive the information from Purchasing in MFG/PRO, the same local system that is used by all the other areas in VBM. In addition, Logistics works with the information that is provided by the Process Engineering department. When Logistics has all the information they need, it is responsible to look at the structure of the product and the demand for the materials that are needed. This task is run through the MRP (Material Requirement Planning) system, which deals with inventory and planning. More specifically, it deals with issues related to what you planned and when you will start working. Logistics would then put their input in the system and prepare the release. The more accurate the information they receive from the other operational areas, the higher the quality of the release made by Logistics. However, quality can be threatened when data is put manually into Excel sheets before it is sent by fax or by mail to the supplier. After the Call Off is made, Logistics can supply the material to Production. The whole procedure and delivery often takes a lot of time.¹³²

5.1.7 Traffic

The Traffic department is actually the Import department of the company. It includes the Head of the Department, one employee and two trainees. This department depends on several operational areas. It can be said that Logistics is Traffic's principal and direct internal client. In addition, Traffic also deals with the Finance department, particularly with the Costs, Accounting and Treasury divisions and also works with the Warehouse.

The main function of the Traffic department is to prepare all the necessary documents in order to obtain the chassis material from VBB. In order to accomplish this, Traffic needs to make the necessary arrangements with the Logistics division in Sweden who will contact the suppliers. They depend a lot on Sweden at the moment to fulfil their operations. The suppliers will receive a schedule in order to ship the material and will also contact the shipping company who also works with Volvo Logistics. This shipping company is in charge of putting the material into a container and producing a Pre Alert document, which they send to the Traffic department. This document indicates the details of the materials inside the container and data related to the shipment.

¹³² Pedro Espinosa, Head of Logistics, 2003

The Traffic department would then make a follow up of the Pre Alert document and a few days later it will receive the Bill of Lading (custom authorisation document), supplier invoice and packing list. This information is then reviewed, matching the codes and comparing the specifications in the documents. Later these documents are sent with an instruction letter to their custom broker in order to do the customs clearance. Many of the documents are filled in manually, making it a time consuming task. At the same time Traffic will also deliver these documents to the Warehouse, Accounting and Cost departments. After several transactions at customs, Traffic will emit the customs declaration. This customs declaration is made when the company is sure that the material is in the customs area. This means from when the material enters Mexican territorial waters, and not necessarily when the material is on dock or at the port. Usually all the necessary papers to do the customs clearance are ready when the materials arrive at the port.

Traffic then waits until the vessels arrive to the port in order to take out the material. The normal time it takes to clear customs is around two to three days. When lucky, the customs clearance can be made in a couple of hours on the same day the vessel arrives. It will all depend on the delivery conditions and the urgency by which the material is needed. After the custom clearance, the Traffic department receives the material in VBM's Warehouse. When the Cost department knows exactly how many buses were produced they will send this information to the Traffic department in Excel format via e-mail. Traffic then sends this information to the custom broker, who produces a document to pay the corresponding taxes according to the different FTAs and/or PROSEC* conditions. Finally, the customs broker will emit another customs declaration indicating that the taxes have been paid.

5.1.8 Warehouse

General Warehouse is composed of four areas, namely Material Reception, Storage, Assortment, and Production Line Delivery. Currently there are nine blue collars and one white collar employees working in the Warehouse. The Warehouse department is responsible for receiving all the material from the suppliers and identifying if there are any missing parts. Unfortunately, there is

* PROSEC is a Mexican governmental programe aimed at creating more jobs by reducing the customs taxes for certain products imported into the country. It allows companies to pay zero tax for a complete Chassis, broken down in Part Numbers, delivered in the form of a CKD Kit.

no good control system to help the Warehouse to identify missing parts in a fast and accurate manner. If the invoice or the customs declaration is not in accordance to the material they are receiving, they will write a note on the document stating the difference before it is sent to the Finance department. Soon after the material is received, Warehouse will start the process of storing the items according to a specific classification. Later Warehouse will assort the material according to their family code and importance of future usage, and finally deliver the material to the different work stations in the production line according to the scheduled Master programme. The Planning report or Master programme used by the Warehouse comes from the Production Control and Planning Department. All work at Warehouse is done in the MFG/PRO system.

5.1.9 Finance

The Finance department is composed of nine people and four trainees. However, the department is expected to include two more employees in order to handle suppliers. The main areas that most of the other ten operational areas depend upon in Finance are the Cost, Accounting and Treasury areas. This department supports the rest of the operational areas in all the transactions made. Their support would start when the initial order is made and would finish when the material purchased is in hands of VBM. It is the interest of Finance to sustain cost efficiency at all times.

5.1.10 Information Technology

The IT department is composed of approximately twenty people. This department is responsible to help and support the other operational areas with any concerns regarding the existing systems. This means, that they will look into the issues regarding the data flow from the KOLA, GPS and more specifically regarding the local MFG/PRO system, just to mention a few. The competence and capability development is very important in this division. Similar to the Finance department, IT is also in charge of providing support to all the operational areas from the beginning of a transaction until the end of the operation. In addition to this, IT is also involved in the availability and maintenance of computer equipment, and is in charge of any programming matters.

5.2 Main Issues and Concerns of VBM Operational Areas

As illustrated in Figure 2 (p. 12), ten operational areas were identified to be important to consider when a CKD Chassis Assembly Plant decides to upgrade to a PN Factory. Following the aim of this thesis to identify the issues and concerns imbedded in each one of these ten departments, we have followed and used our conceptual model previously described in Figure 6 (p. 43). The issues that we acknowledged after the study at VBM helped us understand how the proposed PN Factory upgrade process for the Chassis line will affect VBM's operations.

More specifically, and as briefly discussed in the methodology chapter, this involved gathering information so that a thorough appreciation of the main concerns that need to be addressed could be identified. The data was mainly gathered through the qualitative interview process, where managers of each operational area concerned were approached. Through this process it quickly became apparent that there were similar thoughts regarding most of the issues and concerns in almost all operational areas.

In addition to this, other interviewees were approached so that a view from employees outside the direct operational areas could be obtained. Thereby a broader and perhaps less subjective understanding to the issues could be provided at the same time as giving more validity to the information gathered. For a more detailed list of the interviewees and their respective operational area, please refer to Appendix 11-6.

Once the interviews were completed, the sorting process of the issues took place, where we grouped each issue and concerns under a heading according to its nature. This process was then undertaken once again where the identified issues were grouped into broader topics. This was because we thought it would be easier to manage and comprehend these issues and concerns as many of them were interlinked. This was made in accordance with our own understanding and interpretation of the information gathered, thereby obtaining a more manageable number of issue areas to work with. These issues and concerns are illustrated below taking into account the opinion of each operational area.

Table 3 Main Issues and Concerns at VBM

Operational Area	Issue/ Concern							
	Cost	Systems	Suppliers	Process	BOM	DCN	HR Needs	Other
Product Development Engineering				X	X	X		
Process Engineering	X		X	X	X		X	X
Beredning		X		X		X	X	
Production		X	X	X				X
Purchasing	X	X	X	X	X	X	X	X
Logistics	X	X	X	X	X		X	
Traffic	X	X	X	X			X	
Warehouse		X	X	X	X		X	X
Finance	X	X	X	X			X	
IT		X			X	X	X	

After having identified the main issue areas in VBM, we will now look into each issue exposed in the table above, starting off with costs and continuing the same sequence as detailed in the table. The identification and description of the problems and concerns in each department can help us understand and acknowledge the impact on the competitive priorities deemed to be important for the competitiveness level of a manufacturing plant. The table above does not intend to classify any above-mentioned issue and concern or operational area as more or less important than another.

5.2.1 Cost

The cost issues concerned with the potential upward migration to a PN Factory seem to evolve around the following areas:

- The production volume that can justify a PN Factory upward migration.
- The costs breakdown for a CKD Kit in terms of direct/indirect costs.
- The effect on overhead costs currently paid to maintain the CKD operations in Sweden.
- The effect on customs duties and taxes currently paid.

5.2.1.1 Volume

The justification to become a PN Factory is argued to be very dependent on the production volume in a plant and the number of chassis ordered per year. This is believed to have an impact on the general costs issue and the savings that can be made. The appropriate volume to justify a PN Factory migration seems hard to establish and varies according to whom is spoken to. However, this product volume is believed to lie somewhere in between 1000 – 1500 Volvo Buses per year. VBM is currently buying around 1000 Chassis per year.¹³³ According to Claes Göran Persson, CKD-Operations Manager at VBB:

“I think it is a natural step for a company to upgrade its operations from a CKD plant to a PN Factory when more than 800-900 bus units have been manufactured during a period of time. Maybe 1,000 units and I mean Volvo units, of course.” “For Mexico it is a bit difficult to say how the situation will be. The plant produces around 600 Volvo units. Of course an important step is to actually to see how their resources look like.”

However, what is also important is that the production volume is steady. Hence, it seems like even though there is a volume justification for the VBM to become a PN Factory at around 1000-1500 produced buses a year, the justification is more a question of steady or growing volumes over a period of time. Demand should not face the risk of slowing down in the foreseeable future as it is argued that fluctuating production volumes could have an impact on the savings that could be made in becoming a PN Factory for chassis.¹³⁴

5.2.1.2 Cost Breakdown

The savings that can be made are also dependent on the total cost of buying a CKD Kit. However, it seems like the exact cost breakdown for a CKD Kit from VBB is not known or established within VBM. Therefore it is difficult to know what the exact costs to deliver to the local goods receiver will be.¹³⁵

¹³³ Mats Lindevall, Global Buyer; Rafael Kisel, Purchasing Director; Claes-Göran Persson, Manager CKD-Operations and Projects, 2003

¹³⁴ Tomas Fransson, Chief Information Officer Volvo Buses, 2003

¹³⁵ MatsLindevall, Global Buyer, 2003

The exact cost breakdown by cost item of a CKD Kit will need to be established in order to know what the potential costs savings could be. This is a view shared by all of the interviewees. These include not only costs for direct material, emballage, man hour costs, CKD Kit material reload and packing costs, but also surcharges, purchasing charges, design surcharges, management costs, sales, customs charges and many others. The closer department at hand to have this cost breakdown should be VBB but they are unlikely to hand these over without some pressure from HQ.¹³⁶

Knowing the exact cost breakdown of a CKD Kit could help the Purchasing department, for instance, to know how much it will cost them to handle the extra amount of suppliers that becoming a PN Factory will mean. This is something that might affect the final price of the bus. In order to clearly understand the potential cost and savings issue, VBM will need to know the difference in price of buying individual part numbers compared to a CKD Kit from VBB.

In addition to this, there are concerns that costs could actually rise. Rafael Kisel, Purchasing Director, argues that not only will the Purchasing administration costs increase but Logistics and Warehouse would also increase their daily workload although the shipment and transportation costs would stay the same. Mats Lindevall, Global Buyer, argues that VBM might be able to reduce their direct costs and especially labour costs as this resource is much cheaper in Mexico. The Project Engineering department also shares this view.

When discussing the costs and the savings that can be made in becoming a PN Factory, Consultant Tomas Håkansson, provided a good description of the general situation. According to him, the CKD concept is well developed specially to serve factories such as VBM. He continues by stating that maybe 10 -20 percent of the cost of a CKD Kit could be saved if VBM were to become a PN Factory for Chassis. According to him, added costs to a CKD Kit can be broken down as follows:

- Service, Logistics and Instructions
- Surcharges and overhead costs for operations in Gothenburg
- Profit margin for VBB.

¹³⁶ Enrique Rustrián, Head of IT, 2003

He argues that there is an estimated added cost to a CKD Kit of around 50-70 percent, which in his belief is not very much. The reason for his statement is that becoming a PN Factory would mean that more people would be needed in Mexico to compensate for the increased workload, surcharges would not or could not be reduced and the savings on the profit margin would just be a question of changing money in the same pocket.

5.2.1.3 Surcharges and Overheads

During the empirical data gathering process it became evident that the issue of surcharges and overhead costs was frequently mentioned. It is believed that although the direct costs of buying the material directly from the suppliers can be reduced it is important to remember that there are overhead costs associated with maintaining the whole CKD system in Sweden.

These overhead costs are more specifically concerned with global purchasing, services, management costs, development costs, engineering activities and other costs, mainly from operations in Sweden. Today it is believed that much of these surcharges associated with the maintenance of the whole Volvo CKD system are placed within the CKD Kit itself. The argument is however, that even if VBM were to start buying Part Numbers directly from the suppliers, they would still have to pay for these surcharges. Currently, these overhead costs are spread across all global plants buying CKD Kits from VBB. Hence it is therefore argued that these costs need to be understood before an attempt to become a PN Factory is undertaken.¹³⁷

Rafael Kisel, Purchasing Director, argues that these surcharges currently being paid to VBB can be reduced if transferred to VBM; as they probably are bigger in VBB then they would be in VBM. What needs to be avoided is to have surcharges in both plants as this cannot be afforded.

Although global purchasing surcharges are negotiated for, and paid separately every year by VBM, the administrative local VBB and global costs included in the CKD Kit are not known in detail. If VBM can manage to establish what the direct costs for the CKD Kit is, they might be able to lower their administration costs. In addition to this, as Mexico is a low cost country compared to Sweden,

¹³⁷ Mats Lindevall, Global Buyer, 2003

at least in terms of direct costs for e.g. labour, there are greater opportunities to make larger savings here. Either these costs can be made to disappear altogether or perhaps any surcharges paid can be passed from VBB to Volvo Logistics with an opportunity to renegotiate new charges.¹³⁸ This view is also shared by the Process Engineering Department.

PED believes that surcharges for Product Development Engineering in Sweden will not decrease, as this operation would still be used in a similar way as now. What needs to be taken into consideration is that there are surcharges in VBM as well, and there will be a need for a new way to calculate these. If surcharges for Sweden are reduced then a situation where surcharges in VBM would increase should arise.¹³⁹

5.2.1.4 Customs

It was also argued that there are additional costs that will be incurred if VBM was to become a PN Factory for chassis. According to Arturo Alanís, Head of the Traffic department, this migration will generate an extra cost and additional work in the customs clearance processes. The concern lies around the fact that if VBM is to buy and import components individually, different tax rates for each part number will need to be applied in the customs clearance processes. This is to be compared to the single tax rate currently used for a CKD Kit. This rate is dependent on the country of origin for the item in question and whether this country has a Free Trade Agreement with Mexico, if the item falls under the PROSEC Program, or whether it has no special treatment at all. Arturo Alanís continues by stating that the Traffic department will need a list of all the material by Part Number in order to identify exactly what tax needs to be paid. The information requirements are basically three things:

- What the Part Number is
- The technical description of that Part Number
- What technical support the Part Number requires

Knowing these three things would make the work of Traffic easier in becoming a PN Factory for chassis. Without the technical description it will become difficult to know which custom code to apply for the imported material. These

¹³⁸ Rafael Kisel, Purchasing Director, 2003

are details that VBB should have but there might be a risk that this is not the case. Arturo Alanís suggests that VBB might have to obtain all this necessary information from all the different suppliers in order to obtain the complete details of every part number. This is believed to be a crucial need before attempting to become a PN Factory.

The potential increase in costs is also shared by Mats Lindevall, Global Buyer, who argues that as the CKD Kit is currently very efficiently packed, it could become more expensive in terms of shipment and logistics if parts were to be delivered in smaller quantities by several suppliers. Although it has been argued that Volvo Logistics can be used to resolve this issue it does not necessarily mean that they can make it cheaper. Becoming a PN Factory would furthermore mean that VBM will be in charge of the cash flow, and also that they will be more responsible for the inventory level of the material that goes into the Warehouse.¹⁴⁰

5.2.2 Systems

In terms of software systems used within VBM, interesting and sometimes conflicting observations were made during the empirical data gathering process. The software's used by VBM are crucial in the day-to-day work within the factory. Some of the systems used are Volvo Corporation wide whereas others are more VBM specific and some even department specific. However, looking at the major systems used, and identifying the most important ones as leading from the interviews made, several issues and concerns surrounding the systems used became evident. More specifically, the issues are related to:

- Implementation Process
- Manual procedures
- The systems used to communicate with Sweden.
- The transfer of data between the systems - interfaces
- Systems handling and process issues
- EDI
- KOLA
- GPS
- MFG/PRO

¹³⁹ Hector Nuñez, Head of Process Engineering, 2003

¹⁴⁰ Pedro Espinosa, Head of Logistics, 2003

5.2.2.1 Implementation Process

According to VBC Chief Information Officer, Thomas Fransson, the IT structure at VBM is still in transition. When Volvo Bus Corporation required MASA, the company had its own IT structure and new systems had to be implemented in certain parts. As a result of this, VBM is currently using old MASA systems and new Volvo Bus systems. The problem is that when the integration of the Volvo Product Development and the local Product Development took place, there was a mismatch. This situation is still present today and it has not yet been completed.

From an IT technical point of view it is argued that it is almost completed, but certain procedures are still necessary to be put in place for the whole structure to work well. Thus, different ways of how to combine the work in the factory must be looked at. In any Volvo Plant there are two different structures, namely the Product Document Management (PDM) system structure and the Production Structure. The factory system area (MFG/PRO) falls within the Production Structure. The difference between these two is that the factory system provides feedback to the designers.¹⁴¹

This has given rise to a few problems as the design responsibility lies in Gothenburg whereas VBB has its own structure for a bus. Hence there might be a slight variation between the two structures and deviations between the design and factory system if VBM is to become a Chassis PN Factory. The reason for this can be attributed to the customer adaptations being made within the Production Structure. There is a general design in PDM and customers have special requirements in the factory systems production area. Many times a customer wants to adapt a chassis to the body. There is also a lot of design in this process where the designers make some changes to the “copy” of the PDM system structure.¹⁴² Please refer to Appendix 11-13 for a more detailed description of the global IT systems used at VBC.

¹⁴¹ Thomas Fransson, Chief Information Officer Volvo Buses, 2003

¹⁴² *ibid*

5.2.2.2 Manual Process Issues

At the moment the Beredning Department is making most of their job manually when they receive the documents on which they do their analysis. The analysis information is furthermore registered in Excel sheets and sent by email to other departments such as Purchasing, Logistics, Process Engineering, and Production control.

The Traffic Department is also undertaking some of their activities through manual procedures. One such procedure is related to the customs declaration, which must be filled in by hand. In addition to this, Traffic uses the Internet and e-mail to contact their customs brokers. Since all the procedures and all internal documents are made and sent in paper, it would be good if they could be replaced by an electronic system, as it would mean tremendous improvements in process efficiency.¹⁴³

It also became apparent that invoices for material call offs are received in paper format. Receiving these electronically would mean tremendous improvements but in order to make this happen, the suppliers must have the same system in order for the process to run smoothly. However, according to Arturo Alanís, Head of the Traffic department, VBM is not ready yet to implement all these electronic procedures. Nonetheless, if it plans to upgrade its operations to a PN Factory, then it will need a system in order to circulate all these documents faster and more efficiently.¹⁴⁴

5.2.2.3 Communication with Sweden

The need to have local and global systems that can communicate with each other has been highlighted throughout the data gathering process in Mexico. This refers especially to communication between all VBM departments, as well as with those located in Sweden and around the globe. The reason for this need is because VBM is currently dependent on so much information coming from sources outside the plant itself and this dependency is likely to continue into a foreseeable future.

¹⁴³ Arturo Alanís, Head of Traffic, 2003

¹⁴⁴ *ibid*

The main issue is to ensure that the local systems and the different Volvo Corporate wide systems such as KOLA, which is a construction system that contains the construction documentation and the Global Purchasing System (GPS) are used in order to facilitate the use of one language between the systems. These are all global systems that need to have the same data and information structure so that all information can easily be shared and understood by all parties. These systems are especially important for the Beredning department, although it might be necessary to create other interfaces with other systems as well to provide for the needs of other departments.¹⁴⁵

Interesting to note is that Beredning is of the understanding that in the future they will need to use the Volvo systems more and reduce the use and reliance on MFG/PRO. Further to this, if VBM is to become PN Factory, there might be delays occurring in the delivery of material. In such event it is important to have systems that use the same language in order to quickly establish what needs to be done and co-ordinate between Sweden and themselves.¹⁴⁶

In a similar manner, Mats Lindevall, Global Buyer, highlights the problem that might arise when the information kept in the systems is not of the same kind or has the same structure. He specifically highlights the issues with the KOLA systems and the way in which new items are introduced. It is the general understanding that all new items or part numbers, should be born in the KOLA system as a Design Change Notification (DCN).

However, a situation currently exists where part number codes are different in the systems used in different plants. As a result, there is a need to have and use the same system in order to speak the same language when discussing one similar part across the whole company. In order to reach this goal, there is a need to use the same design and purchasing system across the company. However, any current problems experienced seem like they can be attributed to process issues rather than IT issues as it is argued that Volvo Plants around the globe are not following the rigid rules and procedures set out for them.

¹⁴⁵ Arturo Alanís, Head of Traffic, 2003

¹⁴⁶ Ignacio Aguirre, Head of Beredning, 2003

5.2.2.4 Interface

According to the Head of Beredning department, Ignacio Aguirre, one way of overcoming the issues with having systems that do not speak the same language is to invest some more resources into developing the interfaces and the links between the current system and all other Volvo Systems. Mauricio Meugniot, Head of CKD's, also identifies the need for adequate interfaces between all the main systems and the systems used in Sweden. His view is that there could be a problem in VBM if it is to become a PN Factory and the data in the system is not being correctly and timely updated with the new amendments. If this update is not done to the system, then it could lead to several specification issues.

There is furthermore no interface between the KOLA system and the GPS. This is why at the moment all the information coming from Beredning regarding the DCN implementation in the KOLA system is put in manually in the GPS. It is also important to consider that if VBM upgrades from a CKD Chassis Assembly Plant to a PN Factory, there needs to be a better link between Engineering in Sweden and Beredning in Mexico.¹⁴⁷

5.2.2.5 System Process Issues

One of the system process issues highlighted during the empirical investigation was concerned with the local factory system MFG/PRO. Currently this system is updated once a week, on a Sunday, to record all the changes made in the global KOLA system. However, these updates only provide a snapshot of the information that has been stored as the updates are not made frequently enough. Due to this, the information in the system does not accurately reflect the changes in the system in terms of material required. This is one of the reasons why Logistics feel that they need to use Excel sheets to do their job correctly. This is in contrast to other bus companies who are believed to make their system updates more frequently, perhaps on a daily basis, hence being in better line with their suppliers and the request they put forward to them.¹⁴⁸

¹⁴⁷ Enrique Rustrían, Head of IT, 2003

¹⁴⁸ Rafael Kisel, Purchasing Director, 2003

By running the updates as frequently as possible, it will become easier to ensure that the material needed is accurately reflected in the system. On the other hand, although these updates are only run once a week, the changes in material need are so many that they are impossible to track and follow.¹⁴⁹

5.2.2.6 EDI

At the moment the contact between VBM's Purchasing Department and their supplier is done through fax or email. This is because Electronic Data Interchange (EDI) with the suppliers does not exist. It is believed that in the purchasing departments in Sweden they are using or pushing for the use of EDI (web based). Purchasing Director Rafael Kisel, believes that EDI is one of the biggest improvements required for VBM to become a PN Factory. The reason for EDI not existing or not being on the agenda is believed to be because of its implementation costs.

Another department that could benefit tremendously by the use of EDI is the Logistics Department. Having access to the use of EDI would help to facilitate their daily work. It is believed that an additional 1500 Part Numbers and around 50 new suppliers will have to be managed if VBM became a PN Factory for Chassis. The use of EDI would be very helpful in managing this. It is also believed that since all the necessary information needed to create an EDI with the supplier already exists; it is possible to solve this issue. What will be required is to sort the data already existent in MFG/PRO in a different manner. The use of EDI would mean less use and dependency on Excel sheets and less risk of human errors.¹⁵⁰

5.2.2.7 KOLA

As mentioned, the KOLA system is a system that contains the construction documentation, and is furthermore used throughout the whole Volvo Bus Corporation. The main limitation of the KOLA system for VBM is that it does not give access to the complete Bill of Material (BOM), which contains all the information necessary for the production of a bus. The reason for this is that the system does not have all the information required for production but merely stores the design information. Hence what the KOLA system does not store is

¹⁴⁹ Rafael Kisel, Purchasing Director, 2003

¹⁵⁰ Perdro Espinosa, Head of Logistics, 2003

the process information needed for production. The process today is such that some 80 percent of the existent body engineering is made and stored in the KOLA system, and then through an interface this information is received and added to the MFG/PRO system.¹⁵¹

In addition to this the problem seems to be that not all the necessary KOLA information gets through the interface with MFG/PRO but that some of it gets stuck in-between. The process to overcome this is then to print a pending data report to complete the missing information manually. This relates to information such as installation points, phantom codes, process codes, and extra raw material. This information is not stored in the KOLA system but is rather part of the MFG/PRO system. The KOLA system only gives information on the specific part number to be used and the specification of the material but never tells you the part number for the raw material to buy. Hence, there is a need to complete this information manually.¹⁵²

Enrique Rustrián, Head of IT, argues that that the main problem and solution to this issue lies in convincing the responsible part in Sweden to send all the necessary information through the KOLA system. This, according to him, would require some political pressure and strategic reasoning in order to clarify why VBM need more product classes in terms of the chassis.* His argument is that there is no problem for VBM's current systems to receive this additional information as the systems are believed to be ready, robust, and flexible enough to handle this.

What might be required is for Sweden to change the filter of the interface so VBM can receive the necessary chassis information. Some minor and not so significant modifications to the interface might be required. A request needs to be put forward for this change and approval obtained. Getting this approval is however believed to be difficult to obtain and although it is an important request there is a risk of not getting it. Someone will need to approve a strategy for this and also approve the monetary resources necessary for this; hence it is believed to be more a business decision that needs to be taken.¹⁵³

¹⁵¹ Enrique Rustrián, Head of IT, 2003

¹⁵² *ibid*

* The chassis consists of product classes 11, 12, and 13

¹⁵³ Enrique Rustrián, Head of IT, 2003

Enrique Rustrián continues by stating that his belief is that the full access to the BOM information in the KOLA system will never be obtained. However, this is not something that VBM would require anyway. It is believed that the decision for the accessibility to this information needs to be taken at a high strategic level. If enough pressure is put on Volvo IT in Sweden they will find it very difficult to resist the request to create the filter to extract the information that VBM needs. It is also believed that there are adequate human resources available in the IT department to handle these changes.

5.2.2.8 GPS

The Global Purchasing System (GPS) is a procurement system used to negotiate with suppliers and to create contracts that include information on delivery conditions, prices, and annual volumes.

According to Enrique Rustrián, the difference between GPS and MFG/PRO is that the former is a purchasing system whereas MFG/PRO is a logistics system. However, MFG/PRO has purchasing functions as well but corporate decisions stipulated that it would be used as a logistic system only. Hence GPS procurement data is copied into a procurement module in the MFG/PRO, and this information is necessary for the Logistics department in order to create the material Call Offs.

It is also stated that a part number that exists in the KOLA system needs to exist in GPS as well in order to be able to produce Purchase Orders. However, since Volvo Bus Borås (VBB) is already buying all the components for the chassis, these part numbers should exist in GPS.

Nonetheless, although an interface between GPS and MFG/PRO exists, not all necessary information is received and some need to be added to the system in a manual process such as with the KOLA – MFG/PRO connection. This is argued not be a technology problem but rather that the information is not stored in GPS or simply not sent, although VBM could receive this information without any problems.

5.2.2.9 MFG/PRO

MFG/PRO is the logistics system used by VBM and the system through which the important Call Offs for production material are made. More specifically, the MFG/PRO has three distinct parts to it namely Distribution to move articles, Manufacturing to handle manufacturing operations, and Finance/ Accounting. The MFG/PRO can handle many issues and operations related to these three main modules and is believed to be a good factory system although it s not so complex.¹⁵⁴

However, as discussed with the KOLA system and GPS, all the necessary information is not stored within MFG/PRO. The reason for this is that it might not be properly supplied or be encountering conversion issues leading to requirements to handle it manually. If any of these manual procedures are not carried out, the result might be the experience of financial issues and inventory problems. Hence there might be some need to further define the way by which the information concerning the Bill of Material (BOM) is introduced into the factory system MFG/PRO.

This information is needed in order to create the BOM explosion, taking into consideration sales and inventory amongst other things, and furthermore has implications for the creation of material Call Offs to the suppliers.¹⁵⁵ The impact and dependency of MFG/PRO for the business is enormous although it is believed to be replaced with SAP in the near future in a world wide project aimed at ensuring that all Volvo plants use the same systems.

According to Enrique Rustrián the idea of buying SAP is good as it means that all Volvo Plants will be using the same system. The problem is the cost, as it is difficult to justify a 3.8 million dollar investment, in addition to 1 million USD per year in maintenance costs. The question is why VBM should spend so much money for something they arguably already have in the form of MFG/PRO?¹⁵⁶

However, Chief Information Officer Thomas Fransson argues that using the MFG/PRO system for handling the PN Factory processes for chassis in Mexico

¹⁵⁴ Enrique Rustrián, Head of IT, 2003

¹⁵⁵ Ibid.

¹⁵⁶ Ibid.

might not be such a good idea. Although this system is adequate to handle body processes, he believes that a lot of additional investments have to be made in order for the system to be able to handle new chassis processes as well.

He continues by arguing that what is needed for VBM to become a PN Factory is a change of factory system from MFG/PRO to a use of the system used by VBB. Currently they are not using the same system. Alternatively, the current VBM factory system, used primarily in the body processes, must be updated. Nonetheless, as it is planned for this system to be replaced by SAP within the next few years, it is vital to establish whether this is the right time for the PN Factory upgrade. He believes that flexibility lies within, and can be obtained through, the factory systems used by the plants and this could be further improved by using SAP.

The use of the SAP system for the chassis processes, would also allow an easier facilitation for central consolidation of operations. This will lead to higher control compared to what can be obtained through MFG/PRO, which has had several control issues over the years. This has, for instance, led to a situation where employees in the Planning Department do not have any trust in the system. One reason for this is that they believe that changes made in KOLA and to the BOM and the structure of a bus are not updated or put in the system correctly. As a result, the planners feel that they need to constantly communicate with the production line so that they can get a clearer picture on what their needs are.¹⁵⁷ Fernando Bastida, Controller, attributes this problem to the lack of correct information in the system. It must be assured that the system is used correctly and that more control is provided.

He also argues that the MFG/PRO will need to be modified in order to be able to work with the extra suppliers and different currencies that an upward migration would mean. The Finance Department use MFG/PRO to deal with the suppliers and believe that an improvement and adjustment to the system will be needed in order to handle more suppliers and codes. It is also, believed that a list of information regarding all the suppliers is needed with information regarding the currency they sell in, the payment conditions, and commercial conditions. The Finance Department think that they are ready to deal with the

¹⁵⁷ Pedro Espinosa, Head of Logistics, 2003

issues in MFG/PRO once it is adapted to their needs in terms of the extra supplier and code information.¹⁵⁸

Head of Warehouse, Emilio Torres, also argues that what is needed for the upward migration is the integration of the chassis information into the MFG/PRO system. This will allow Warehouse to have more control of the material used, as it then will allow them to see the existence and assortment of the missing parts, which will help them in their daily work.

What Warehouse needs is to receive the information part by part, and integrate it in the local system in order to know what to do with the material and when the material will change. Warehouse will also need to understand how to integrate all the different parts into the local MFG/PRO system.¹⁵⁹ This view is also shared by the Production Director, José Martínez who argues that, although this might mean more work, it will nonetheless give more control.

Currently, the procedures for the chassis process is not in the MFG/PRO system and only a few chassis parts are existent in it. In order to have all the necessary chassis information in the system, many different departments will need to get involved. It will be difficult to establish the exact time it would take for the chassis information to be included in the MFG/PRO system as it will depend on several departments and on the resources they would require.¹⁶⁰

5.2.3 Suppliers

One of the important issues regarding an upward migration of a CKD Chassis Assembly Plant to become a PN Factory is related to the supplier relationships. At the moment VBM is negotiating directly with VBB and has no direct contact with their suppliers. By upgrading its operations the first change that VBM would experience is hence in connection with the direct contact towards their suppliers. In order to have a better understanding of what issues are involved with this change, we have summarised them as follows:

- Direct contact with suppliers
- Purchasing Agreements
- Delivery of the Material and Lead Times

¹⁵⁸ Fernando Bastida, Controller, 2003

¹⁵⁹ Emilio Torres, Head of Warehouse, 2003

¹⁶⁰ *ibid*

5.2.3.1 Direct Contact with Suppliers

To start contacting the suppliers directly would definitely mean more workload for most of the departments at VBM, in particular for the Purchasing, Traffic and Logistics departments. This is because at the moment the company is only receiving one CKD Kit for a chassis and later it would start receiving the chassis by individual part numbers. The suppliers will not deal with VBB any longer but will have to negotiate directly with VBM. In order to fulfil this goal, VBM has to be prepared and has to adapt carefully to the new situation. At the moment, not all the systems are ready to manage this upward migration because the systems still do not have all the supplier information that is needed.¹⁶¹

Additionally, a lot of effort has to be put in sustaining a good relationship with their suppliers. VBM has to constantly use the Supplier Evaluation Model (SEM) in order to identify where the problems might lie, separating the good and the bad suppliers from each other, and always try to obtain the best supplier to satisfy the customers' needs. To continue working with a good supplier and ensure that the delivery is made on time, will mostly depend on the negotiation ability of the Purchasing department. The current supplier database used by the Purchasing department will also grow as they will need to add all the suppliers VBM will work with as a PN Factory.¹⁶²

Although the SEM is a very accurate system where suppliers are classified according to certain quality and delivery standards, not all the departments are satisfied with some of the suppliers they currently work with. It is hence very important for VBM to re-evaluate the suppliers currently working for them and eliminate the bad ones before upgrading their operations. If the suppliers comply with most of the variables in the evaluation model, then Purchasing will be able to assure that the suppliers VBM is working with are good and trustworthy.

Today, it seems that no follow up is being made by the Purchasing department to continue using only high quality products and serious suppliers.¹⁶³ Many departments are concerned with quality issues related to several suppliers that

¹⁶¹ Pedro Espinosa, Head of Logistics, 2003

¹⁶² *ibid*

¹⁶³ Pedro Espinosa, Head of Logistics, 2003

the company has worked with for years. It is important that the company looks into the quality issues when applying the SEM and to be strict when choosing a new supplier.

Moreover, it must be mentioned that the aim to work with good suppliers is to ensure that they can provide VBM with all the material the company needs in a specific time period, and whenever it is requested. With a PN Factory, these three issues have to be applied even more strictly. The supply of more part numbers will probably increase the possibility for human errors to occur, hence, there can always be a higher risk of missing parts. This is a particular concern for the Production department, since they can not take the chance being forced to stop the production line. Since the chassis is an essential part of the bus and it is used at the beginning of the production line, any change or delay in the chassis will consequently affect the rest of the production line. This reinforces the fact that good suppliers are a must.¹⁶⁴ However, by working as a PN Factory could also improve the quality of the suppliers VBM is working with since they will start having more control over them.¹⁶⁵

The Logistics department must also consider that becoming a PN Factory would mean that more foreign suppliers will have to be approached. This will increase the administration problem in the department. Logistics is already having problems related to foreign suppliers in the local system; they are forced to do a lot of unnecessary manual work given that the information regarding foreign suppliers is not included correctly in MFG/PRO. With a PN Factory, treating these issues could become more troublesome.¹⁶⁶

In the Traffic department, the workload will definitely increase but a bigger concern in relation to suppliers would be the way this department currently is doing business with them. Chassis Part Number suppliers are making a local sell with VBB who is in charge of the export procedures to VBM. With a PN Factory will not only the number of suppliers increase, but all of the suppliers will have to change their way of doing business. This means that they will have to start exporting to VBM. Many suppliers might not know what documents must be included in this new process and might forget to include crucial documents like the Certificate of Origin. Educating the different suppliers

¹⁶⁴ José Martínez, Production Director, 2003

¹⁶⁵ Ramon Gonzalez, Industrial Engineering Co-ordinator, 2003

¹⁶⁶ Pedro Espinosa, Head of Logistics, 2003

about the importance of including all export documentation will ease the work of the Traffic department. If this does not happen, then Traffic will have difficulties in applying the correct tax and/or the correct FTA.¹⁶⁷

In order for VBM to develop their future supplier relationships efficiently, it has been argued by many departments that VBB will need to provide them with all the detail information about their current suppliers. This is mainly related to the new contact people VBM will have to start talking to and of course related to the contract agreements they currently have with VBB. More specifically, the company will need to start getting closer with the people involved with the construction of the part numbers in order to know exactly what they are producing, the time it takes to produce them, the price they charge, the way the suppliers are packing the part numbers, the delivery conditions and the time it takes to transport these part numbers to VBM's Assembly Plant. With this information, they will be able to make sure that the negotiation with their suppliers can stay the same as today and probably develop over time with no major inconvenience. Hence, if the suppliers agree upon the same terms as they currently do with VBB, then VBM will not have major problems. This is mainly because they would start doing the same job as VBB is doing at the moment.¹⁶⁸

The information gathering from suppliers will also help the Warehouse, since by working as a PN Factory the inventory rotation in VBM's plant will increase. The information related to VBM's needs, as to know exactly what part numbers Warehouse will receive and when these part numbers will arrive to the plant are seen as essential details for the Warehouse to work with.¹⁶⁹ Finance on the other hand needs to be ready to work with different countries and different exchange rates. They must be ready to handle new and probably more currencies; hence a supplier contract with specific payment conditions will be needed. Finance suggested maintaining the current contract stipulations, this means using the same conditions that the suppliers have with VBB, in order to have less problems and more control over all of them.¹⁷⁰ Hence obtaining the details of the specifications of each part number from the different suppliers is crucial when becoming a PN Factory.¹⁷¹

¹⁶⁷ Arturo Alanís, Head of Traffic, 2003

¹⁶⁸ Arturo Alanís, Head of Traffic & Pedro Espinosa, Head of Logistics, 2003

¹⁶⁹ Emilio Torres, Head of Warehouse, 2003

¹⁷⁰ Fernando Bastida, Controller, 2003

¹⁷¹ Pedro Espinosa, Head of Logistics, 2003

5.2.3.2 Purchasing Agreements

In the future, if VBM were to become a PN Factory, the purchasing agreements would also have to be re-negotiated. VBM is using Contract Orders at the moment, which allows the Logistics department to provide a schedule of the material needed in a one year period. This schedule is done according to the estimated production line needs. Also, this type of Purchase Order does not include specific quantities and is seen as the most convenient Purchase Order to work with according to Global Buyer, Mats Lindevall. On the other hand, VBM can work with Blank Orders, which are similar to the Contract Orders, only that they are not specifically done for a particular person. There is also the Stand Alone Order, which decreases VBM's flexibility as they need to specify the exact quantities VBM needs. Hence, working as a PN Factory will probably require the use of Contract or Blank Orders and not the Stand Alone Order.

5.2.3.3 Delivery of Material and Lead Times

Looking into the delivery and the lead time between VBM and their suppliers, it can be said that in general terms the process will be the same although more complex. Instead of VBB making the contact with the transport company, it will be VBM doing that job. This means that the transport company will have to deliver the material from the suppliers' plant directly to VBM. It will be important to bear in mind that the delivery contracts with the suppliers might need to be renegotiated. The terms stipulated in the contracts could differ since the suppliers are not dealing with a European Plant anymore but with a Mexican one. The new material flow to Mexico will have to be carefully coordinated by the Logistics department, and could actually be tricky to handle.¹⁷²

Furthermore, becoming a PN Factory will also mean that the part numbers will arrive at different times according to the companies needs and not at once in the form of a CKD Kit as it is done today. This new procedure will increase the work done in customs. The Traffic department will no longer be able to declare only one item; rather it will need to specify each part number separately in order to do the customs clearance. This will naturally take more time and the material could probably arrive later at VBM's plant than it is today.

¹⁷² Nicolás García, Purchaser, 2003

This is an important problem because the company is already having slight delays and missing parts. Therefore it is crucial for them to be more efficient in this aspect before becoming a PN Factory. Increasing the lead time of the material that has to arrive at the plant could stop the production line and this issue could consequently become a major threat for the company. At the moment, if the company is in need of a part number, it is receiving all the parts in one CKD Kit. VBM has to be aware of this issue before they start the project.¹⁷³

Moreover, if VBM were to become a PN Factory, some departments thought that the lead time to get the materials from suppliers could increase if the procedures were not managed correctly. However, the majority of the departments agreed upon a decrease in the overall lead times and with this decrease, they stated that VBM would probably also increase their control and flexibility towards their suppliers. Furthermore, as lead time for freight is approximately five weeks, contacting suppliers directly could have a positive impact on the lead time, and hence could improve the flexibility related to the changes or modifications made to the part numbers.

Today, part numbers cannot be changed during the definitive plan for production where the BOM has to be frozen during the freight. However, if the lead time is reduced, so will the freeze time, ultimately leading to more flexibility for VBM.¹⁷⁴ One issue that has to be carefully looked upon is the quality. Working with more suppliers and decreasing lead times could have a negative impact on the quality if not properly controlled. This is why the additional movement of material must have a good control system.¹⁷⁵

5.2.4 Process

According to Chief Information Officer Volvo Buses, Thomas Fransson,

“There is a general understanding within the company that the upgrading to become a PN Factory is a natural step in a factories development.”

¹⁷³ Arturo Alanís, Head of Traffic, 2003

¹⁷⁴ Rafael Kisel, Purchasing Director, 2003

¹⁷⁵ Hector Nuñez, Head of Process Engineering, 2003

However, it is understood by us that it does not necessarily mean that all CKD Assembly Plants will become PN Factories. It simply implies that this is the next stage of a manufacturing plant seeking to have more responsibility with regards to Part Numbers and more control over inbound operations. Claes Göran Persson, CKD-Operations and Projects Manager at VBB stated:

“In general, it can be said that it is a huge step and a rather big process to upgrade from a CKD plant to a PN Factory. There are many departments that should be looked upon in order to be able to map the whole process. For example the IT, the planning and process departments should be investigated, as well as many others. The resources available in the departments have to be in accordance with what is needed to do this upgrade of the plant.”

“The resources they have today will effect on the possibility to accomplish this upgrade of their plant. However, a threat always exists.”

Nevertheless, he stated that VBB would be eager to help and assist VBM if it was required. Developing the VBM CKD Chassis Assembly Plant to become a PN Factory will have an effect on the processes in all ten departments. It is a complex issue to handle and several factors should be looked upon closer. We have identified several main issues surrounding this upgrade process for the ten operational areas and have summarised them below.

- Readiness level of VBM related to the upward migration process
- Time span to be ready for the Plant upgrade
- The Logistics Department
- Material handling and missing parts
- Taxes

5.2.4.1 Readiness level of VBM related to the upward migration

Although some quality issues exist and further development processes need to take place for body, VBM believes that it is ready for the change. However, according to Thomas Fransson, Chief Information Officer, a lot of pressure has to be put on the structures that are underdeveloped before VBM starts implementing the CKD Chassis Assembly Plant upgrade. He argues that it would be hard to attempt the upgrade before the details and issues on body have been identified. He states:

“Attempting to start implementing the chassis processes before the body processes are complete is believed to be a very difficult and risky operation. It is believed that the implementation and completion of the processes for body will take until mid 2004.”

This statement is reinforced by Rafael Kisel, Purchasing Director, who argues:

“It is believed that there are currently too many problems with the PN Factory for Body in order to attempt to become a PN Factory for Chassis. The concern is that if an attempt to undertake this transformation before these issues have been resolved will consequently lead to increased problems”.

Furthermore, according to him, one way to overcome the risks of handling more suppliers and more material flow during the implementation process is to decide which function group or which part number should be bought for the PN Factory first. Then it would be just a matter of continuing breaking down the CKD Kit part by part. With this process, VBM can take parts out of the CKD Kit one by one and start implementing them accordingly. At the end of this process, the remaining part numbers in the CKD Kit will only be a small fraction of all parts needed for a chassis.

This is a process which already seems to have been started for part numbers such as fasteners, tyres, and rims. He further states that VBM needs to create a more systematic way to do this process of breaking down the CKD Kit for the remaining part numbers. It is believed that a new project team needs to be set up to take care of this process, including people from Product Development, Purchasing, and Logistics.

Arturo Alanís, Head of Traffic, stated that the process of becoming a PN Factory for Body was somewhat different to the situation for chassis. This is mainly because there are less part numbers in a body and in addition to this, most of the parts for body are bought in domestic territory. Furthermore, in the case for chassis the situation is not as simple and easy to manage. There are definitely more part numbers and some part numbers will always have to be imported from Sweden, mainly the engine, gearbox and axles. Since the

procedures are more complicated for chassis, more attention and more control is needed.¹⁷⁶

Whilst talking about the readiness level that VBM has in order to upgrade to a PN Factory, some departments stated that they are ready to perform this upward migration with no major inconvenience. This is mainly because their daily work will not change. The departments that mentioned this matter were Beredning, Purchasing, Product Development, Production and Finance. The statements made by each of these five operational areas are summarised below.

First of all, Ignacio Aguirre, Head of Beredning, stated that he thinks that they will not change the way they are working at the moment. They might have more contact with Europe but in general terms their work method would stay the same but maybe with a more global perspective. However, at the moment all CKD changes are made in Sweden and with a PN Factory Ignacio Aguirre, is not sure how much the impact on his department would be.

Purchasing, on the other hand said, that they will not need to change the way they work today although it does include extra workload for them. The only thing that Purchasing must consider is if they will apply a Contract or a Blank Order. The way the purchasing procedure is made will thus depend on the Purchase Order they decide to work with.¹⁷⁷

Moreover, Kjell-Arne Lindvall, Head of Product Development, also stated that becoming a PN Factory will not change their way of working. They will run the process the same way as they do today. According to them, flexibility won't be that much affected because the design of the chassis will still be made in Gothenburg, Sweden. However, important to mention is that in order to undertake upward migration to become a PN Factory, all past mistakes must be taken into consideration. The time it will take to make the process work smoothly will depend on the amount of resources and effort that is put into the project. Additionally, this department mentioned that they will need to implement a new system for handling internal quality issues called PROTUS.

Furthermore, Production will continue receiving the material in the production line in the same way. It will not be a difference for them since the Warehouse

¹⁷⁶ Hector Nuñez, Head of Process Engineering, 2003

¹⁷⁷ Roberto Almaguer, Global Buyer, 2003

anyway sends the material by part numbers to the assortment and production line. Hence, Production will not need to change the process it is working with today.¹⁷⁸

Finally, for the Finance department, becoming a PN Factory would not be a big problem. They state that they are ready to upgrade to a PN Factory at the moment. It would only be a question of having better control in order to deal with more suppliers and different exchange rates. Nonetheless, Finance did suggest that the local system they currently work with should improve in order to accomplish their work more efficiently. Although their work will be the same, Finance is concerned with knowing if the payment terms with the suppliers would change, meaning that they need to be clear who will be in charge of performing the payment.¹⁷⁹

5.2.4.2 Time span to be ready for the Plant upgrade

In general terms, each department at VBM stated that they would be ready to upgrade to a PN Factory in different time periods. While some said it will be easy and take a short time, others believed that they needed extra support from other departments in the company in order to be certain of the time it would take to undertake this upgrade. Examples of the differences are stated below.

The Beredning department stated that they should be ready to become a PN Factory after they start including the implementation date in the DCN Information System (DIS).¹⁸⁰ The Logistics department stated that they can be ready in maybe three and a half months. However, this readiness level will depend on the support that Logistics will receive from the IT department.¹⁸¹ Purchasing believes that the process can be completed in four to six weeks as it will only require raising around 150 new orders with the same suppliers. Since all parts bought by VBB today for the chassis can be found in GPS, the Purchasing department at VBM do not have to look for suppliers or negotiate any new deals. Everything already exists in the system, making the transfer easy for Purchasing.¹⁸²

¹⁷⁸ José Martínez, Production Director, 2003

¹⁷⁹ Fernando Bastida, Controller, 2003

¹⁸⁰ Ignacio Aguirre, Head of Beredning, 2003

¹⁸¹ Pedro Espinosa, Head of Logistics, 2003

¹⁸² Rafael Kisel, Purchasing Director, 2003

The Process Engineering department thinks that to become a PN Factory for Chassis would take them approximately three months. This is mainly in relation to the process of feeding the correct information into the system and does not include getting the process in place. Given that the department will need to work only with a limited number of product structures, the procedure is not that complicated. However, this time would of course depend on them receiving the list with the part number specifications in order to avoid quality issues with the information flow.¹⁸³

For the entire company to upgrade its operations from a CKD Chassis Assembly Plant and become a PN Factory is a different story. Some interviewees understood that it is an ongoing process that will take place next year while others could not give an exact date and even stated that VBM was not ready to become a PN Factory for Chassis yet. According to Claes Göran Persson, CKD-Operations and Projects Manager at VBB:

“It would take approximately twelve months to upgrade a plant from a CKD to a PN-Factory. Of course depending on the resources of the plant. It is not an easy task to upgrade and it should be taken into consideration that only Brazil has a PN Factory for Volvo.”

Head of Beredning, Ignacio Aguirre and Head of Product Development, Kjell-Arne Lindvall both agreed in their statements and estimated that VBM would be ready to become a PN Factory in the first or second quarter of next year. Pedro Espinosa, Head of Logistics, on the other hand, stated that in order to accomplish the upward migration of the Assembly Plant and know exactly how long the process will take, will depend on the co-ordination of all the VBM departments. In order to know when VBM will be prepared to undertake this upgrade, will depend mostly on the Purchasing department, and on the amount of new suppliers VBM will have to work with. Warehouse states that they do not know how much time it will take for VBM to be ready because they do not know the exact steps that need to be taken for this project. They said that it would be good to know exactly what VBB is doing in order to carry out the operations the same way as them.¹⁸⁴

¹⁸³ Hector Nuñez, Head of Process Engineering , 2003

¹⁸⁴ Emilio Torres, Head of Warehouse; Alberto Febronio, Inventory Control; Rodolfo Fuentes, Warehouse Supervisor, 2003

Furthermore, Hector Nuñez, Head of Process Engineering, stated that it does not think that VBM is quite ready for the change. This statement is made because they have been working almost two years with the implementation for the body processes and till the present date it is still not a complete PN Factory. Before feeding the information into the local MFG/PRO system, he states that there is a lot of work to be done in the rest of the organisation. This is why if VBM were to become a PN Factory for Chassis, the whole process could take more than one year or even the same amount of time as it has taken for body. What VBM needs to think about is how the whole process is going to be implemented. Will it be done by stages like with body or will it follow a different procedure?

According to Mauricio Meugniot, Head of CKD's, VBM must consider that in a chassis you have about 2,000 parts and it is a lot of work to categorise each part individually. He stated the example of a company named Carrus, which used to be a CKD Kit provider for body to VBM. It took Carrus three years to upgrade to a PN Factory for Body. Furthermore, this process for body is not complete yet. Nonetheless only a few items remain in CKD format. So, taking this background information into consideration, he estimates that the upgrade of VBM's operations to become a PN Factory for Chassis could take the same amount of time as they did with body, meaning that it could take three years. Finally Mirsad Sela, Project Manager of CKD-Operations indicated:

*" I personally think that the Mexican Plant is not mature yet for this upgrade.
Maybe in a few more years....."*

5.2.4.3 The Logistics Department

The Logistics department is seen as a critical area to look into. By upgrading the operations of VBM, this department will have more workload because they will have to include all the new part numbers into the system. They are responsible to put the information from the local MFG/PRO system into Excel sheets before they make the Call Offs. Since there are going to be more part numbers to work with, this would also mean that the manual work will increase and thus generate a higher risk for human errors to occur.

Besides this issue, Pedro Espinosa, Head of Logistics, stated that at the moment open orders are creating problems in the department. This means that when a bus is constructed, the production line could have several missing parts. This issue is already giving problems at the moment so with the upward migration of the plant; open orders are something VBM should try to avoid.

Moreover, Rafael Kisel, Purchasing Director, stated that the problems or issues for becoming a PN Factory are also more related to the Logistics department. This is mainly because the business process stipulates that all material Call Offs need to go through the MFG/PRO system. However, this is not always the case which leads to some awkward situations. He stated that sometimes the Logistics Department asks the supplier to send material to the Warehouse without producing a Call Off. Once this material arrives at the Warehouse, they will react with some surprise as this material was not expected. Employees at the Warehouse then usually call the Planner to inform them that they have received material which has not been called for according to their knowledge. What then happens is that the Planners at the Logistics department will produce a Call Off retroactively and send this to the Warehouse who will process the information.

This will of course have implications for the Supplier Key Performance Indicators (KPIs') used in the supplier evaluation, as the supplier as a result of this procedure will always have 100 percent accurate delivery time. It is believed that this situation arises because planners in Logistics feel that it is easier to work via Excel sheets than using the MFG/Pro system. This occurs according to Rafael Kisel because there is mistrust in the local MFG/PRO system. In addition to this, he stated that some people in the Purchasing department also believe that Logistics is not ready to handle the introduction of new chassis parts in terms of system procedures.

An interesting point to consider in the way the Logistics department work is the fact that they admit that they sometimes surpass the Purchasing department in order to do their job faster. For example, if Logistics has missing parts and they need to find a supplier urgently they do not like to wait for the Purchasing department to do their job. They state that sometimes the Purchasing department would take too long. In this case, Logistics would send several e-mails or call a known supplier to get the missing parts required, meaning that Logistics is taking over the Purchasing departments functions.

The Head of Logistics Pedro Espinosa states that he personally does not like to wait for Purchasing to do their job and obtain information which he can obtain faster by himself. To get the missing parts from Purchasing is a time consuming process and this is also a reason why the Logistics department wants to be able to have access to the GPS system and the supplier information it stores. However, the Logistics department would use the GPS system more as a consultation tool. All this must be taken into account for the CKD Chassis Assembly Plant upgrade.¹⁸⁵

5.2.4.4 Material handling and missing parts

In the Warehouse, the same process that is currently done for body parts will be applied for chassis. The only difference would be that they will work with a higher volume of material. However, they would need more control and would need to start working with a Work Order as they do for body. This will help them identify the missing parts and identify which materials are being consumed the most. Additionally, it was stated that by working as a PN Factory could actually increase the amount of missing parts, so to work with a Work Order would facilitate the job.¹⁸⁶

Head of Warehouse Emilio Torres is not the only one concerned with missing parts, hence it is an issue that VBM should be careful with. Although it was stated in VBB that because a CKD Kit has around 1000-1500 part numbers for a chassis it is normal that some parts get lost in the way, this should not be happening. VBB also stated that there is sufficient lead time to cover the mistakes and that VBM was able to handle the situation regarding missing parts with no particular constraints.¹⁸⁷ However, at VBM it was stated that the situation was somewhat different. Most of the departments were very concerned about missing parts and said that before becoming a PN Factory, the issue surrounding missing parts had to be reduced significantly in order to avoid future problems.

From a production perspective the concern regarding the arrival of material is also connected to the previously mentioned issue on missing parts. As stated by José Martínez, Production Director, today VBM has an advantage by receiving

¹⁸⁵ Pedro Espinosa, Head of Logistics, 2003

¹⁸⁶ Emilio Torres, Head of Warehouse, 2003

¹⁸⁷ Claes-Göran Persson, Manager CKD-Operations & Projects, 2003

CKD Kits because they thereby ensure that they receive all the parts in one shot. VBM needs the complete material on time because currently the company is suffering a lot from missing parts for the body. For example, VBM has around 120 missing parts per month for body, which consequently is disturbing the production. The missing parts occur for many reasons. It could be a problem with the BOM, with the suppliers, with Logistics not calling off the material at the right time, and it could also be because there are problems with Volvo Logistics.

The concern of production is that with a PN Factory, the Production department could suffer more of the same problems for the chassis. There will be a higher risk for more missing parts. Since VBM needs to check the complete chassis before sending it to the body line, it is necessary that the material is delivered on time in order to undertake this checking process. VBM can not afford an increase in the amount of missing parts, especially not for Chassis. Overall he states that it is a good idea to continue with the upward migration of VBM's plant, but it is important to get the logistics part to work efficiently.¹⁸⁸

Additionally Alberto Febronio, Inventory Controller, stated that more control will be needed when storing, assorting and placing the material on the production line. The chassis is not included in the local system making the procedure more difficult. Warehouse depends on the information from the process papers and these papers sometimes arrive late. This in turn gives Warehouse less opportunity to know where the material should go.

However, there were some benefits to become a PN Factory for the Warehouse. These benefits relate to the packing of the material, which subsequently would make life easier for Warehouse. They would start receiving one batch with one code and not mixed batches and codes as they are receiving today. At the moment there is an issue with the mixing of “families” and codes for the components coming in a CKD Kit. The new procedure will facilitate the way things are done in the General Warehouse.¹⁸⁹

¹⁸⁸ José Martínez, Production Director, 2003

¹⁸⁹ Alberto Febronio, Inventory Control, 2003

5.2.4.5 Taxes

Becoming a PN Factory would also mean a change in the way Traffic works with the taxation system. As mentioned earlier when discussing costs, VBM has three ways to deal with taxes. They can have an FTA agreement with the country and thus pay a lower tax rate; it can apply the PROSEC programme giving it a preferential tax rate, or have no FTA agreement at all, requiring VBM to pay full taxes on the imported material. These three options will not change; but will take on an increasing importance. The current process of applying only one tax code for the Chassis CKD Kit will be replaced by the need to apply different tax codes for each specific part number. This could lead to several part numbers requiring another tax rate which won't allow it to use a zero percent tax from an FTA agreement or through its inclusion in the PROSEC Programme. This programme has shown to be very beneficial for the company while importing a complete chassis but might not be able to be applied for all the part numbers in the future.¹⁹⁰

5.2.5 *Bill of Material (BOM)*

One of the crucial factors to take into consideration for VBM if upgrading from a CKD Chassis Assembly Plant to a PN Factory is connected to the BOM. This was stated by most of the ten operational areas we talked to. The structure of the bus and its particular specifications are essential for all departments and for the whole process. The main problems related to the BOM are summarised below.

- BOM Creation
- BOM Ownership
- BOM Accuracy

5.2.5.1 BOM Creation

According to Purchasing Director, Rafael Kisel, there are several issues that need to be focused on in order to facilitate the transfer of VBM to a PN Factory for chassis. The BOM creation has been identified as one of the main problems in the general process of the company. It requires primarily high material

¹⁹⁰ Arturo Alanís, Head of Traffic, 2003

availability and accuracy. If it is not accurate, there will be negative implications in terms of missing parts and available material.

According to Mats Lindevall, Global Buyer, VBM is having a problem emitting adequate material schedules and prognosis in relation to the BOM. This can be due to the fact that the company does not own the BOM for chassis and is not prioritising the one they own for body. Since all historical data resides in the KOLA system, VBM can use this system to make future prognosis for the material needed for production. This system allows the plant to know what material and how much of it is needed for the complete structure of the Bus. However, according to Mats Lindevall, it currently seems like VBM is creating a new BOM for each new variant and each new order, hence not making use of the system at hand. This statement was also sustained by Tomas Håkansson, Consultant, who said that creating a new BOM for each new order constituting a lot of problems for the company.

Enrique Rustrián, Head of IT, also mentions that in VBM there is arguably a tendency to put more focus on the product structure than to get a correct BOM, emphasising that this is where all the problems start. If they get the BOM right, then the rest of the process will flow the same pattern. Getting it right and having the right information can also help the company reducing costs.¹⁹¹

At the moment the company is having issues with the way an initial BOM is created. The initial Sales Order BOM (in the Order Delivery Stage) needs to be as accurate and complete as possible, but this is a goal which is hard to complete if there are no good product planning strategies or no good PMR's (Product Modification Request routines) in place. What often happens is that the purchasing of material will be done by a guess. All problems with the BOM could be increased with the potential CKD Chassis Assembly Plant upgrade.¹⁹²

5.2.5.2 BOM Ownership

It also became evident during the discussion with Enrique Rustrián that what is believed to be most crucial for undertaking the upward migration to become a PN Factory for Chassis is the need to have a full, multilevel BOM. According to him, not only can the quality of the BOM be questioned but the fact that

¹⁹¹ Enrique Rustrián, Head of IT, 2003

¹⁹² Enrique Rustrián, Head of IT, 2003

VBM does not have access to a full multilevel BOM and have never received one for chassis reinforces this issue. The company has regarded the chassis as a “black box” for a long time.¹⁹³

The reason for receiving a “black box” for chassis is that VBM does not own the information regarding the drawings for the chassis. Currently, the BOM for chassis is under the ownership of the Engineering department in Sweden. By becoming a PN Factory, and even if Engineering in Sweden is going to maintain the BOM for chassis, he believes that it will be important for VBM to have access to the BOM information in the system. This is mainly because when Engineering in Sweden introduces a change in the chassis, they have no knowledge regarding that change. According to him, it is believed that it will take some major efforts to convince the responsible persons in Sweden that VBM will need to have access to the detailed Chassis BOM.¹⁹⁴

In general terms, and according to VBB, one of the differences between a CKD Plant and a PN Factory is the level of responsibility that resides at each Plant. When using a CKD Plant, the ownership of the bus structure resides with the CKD Plant. This means that the engineers at this plant decide on alterations and variations that can be made on each bus type. If VBM wants a new variation they need to inform the CKD Plant which will investigate the new item and make arrangements for suppliers to produce them. However, when operating as a PN Factory, the ownership of the bus structure is shifted to the PN Factory. This means that decisions regarding alterations, variations, and new items reside with this plant. The factory is hence solely responsible for assuring that suppliers can produce the new items at a reasonable price and at a sufficient quality level. Hence, there is a significant difference between a CKD Plant and a PN Factory regarding the ownership of the bus structure.¹⁹⁵

Finally, the process of purchasing new part numbers and making changes to the chassis will either continue to be handled in Sweden or VBM will have to do exactly the same process as VBB is doing at the moment. The Beredning, Purchasing and Logistics departments will need to be ready for this change.¹⁹⁶

¹⁹³ *ibid*

¹⁹⁴ *ibid*

¹⁹⁵ Claes-Göran Persson, Manager CKD-Operations & Projects, 2003

¹⁹⁶ Mats Lindevall, Global Buyer, 2003

5.2.5.3 BOM Accuracy

It was stated both by Pedro Espinosa, Head of the Logistics department, and by Mauricio Meugniot, Head of CKD's, that it is the responsibility of the Product development and the Process Engineering departments to ensure that the structure of the BOM is 100 percent accurate.

According to Rafael Kisel, the Sales Order is always 100 percent correct in terms of material availability and accuracy. The BOM is usually 98 percent correct and the inventory is usually 95 percent correct. However, the result of these three is less than the individual parts, leading to problems with the final specification and BOM.

On the other hand, Hector Nuñez, Head of Process Engineering, claims that they are 97 percent accurate in the BOM for Body at the moment. The requirements for the chassis in the BOM are really outside the system. In the BOM they only make an estimate of the material they need in production and VBM simply receives a chassis with all the parts. This procedure with chassis could affect the accuracy and quality of the final BOM.

Moreover, Enrique Rustrián, Head of the IT department, explained the importance of having a correct and good quality BOM in order to know what parts are needed for the production. If the part number needed for production is not in the BOM then the system will not plan for it and it will furthermore not be visible for scheduling. In a similar manner, obsolete materials which are stated in the BOM will be planned for although these might not be required to be used in the production. This is why it is estimated that the full BOM requires at least a 99 percent of accuracy.¹⁹⁷ According to him, there are many reasons why the information in the BOM is not correct. One reason is that VBM does not seem to have the right Product Development process in place.

The problems VBM is having with the BOM for Body are mainly because late changes are made to the initial specification agreed with the customer, thereby affecting customer adaptations. The BOM for Body is believed to be no more than around 80 percent correct at the moment on average. It is believed that these two areas, the specification and the BOM are where the problems with

¹⁹⁷ Pedro Espinosa, Head of Logistics, 2003

missing parts and material lies.¹⁹⁸ However, in the case of chassis, this will not be as much of a problem as there are not so many variations and customer adaptations to take into consideration.¹⁹⁹

Another reason why the BOM is not accurate is that VBM is not using the KOLA structure that Product Development Engineering Department has created. By using the KOLA system might lessen the problems the company is currently facing. Additionally Process Engineering Department is sometimes making changes to the structure and this consequently leads to less accuracy.²⁰⁰

The BOM is probably the first or the main problem Logistics has. By issuing an incorrect BOM the Logistics Department will consequently be affected. However, by using the current structure in the local system Logistics is trying to improve a lot of mistakes. Nonetheless, the structure is not 100 percent accurate, and according to Logistics, in order for VBM to work well the company needs to have at least 98 percent of BOM accuracy which they do not have at the moment. This entire situation creates a lot of problems.²⁰¹

If all the information in the structure is not good, then Logistics for instance, will have problems and consequently will have to ask for the materials outside the system in order to avoid stopping the production line. When the structure is wrong, Logistics will also ask for the incorrect material. This is something to take into consideration because Logistics will know that there is actually too much or too little material in the Plant, or that the material asked for is wrong only when the material gets to the production line. As a result of emitting an incorrect structure, Logistics can have a huge overstock or many missing parts. When this happens, Logistics would then need to cancel or delay the material from the supplier.²⁰²

According to Mauricio Meugniot, Head of CKD's, if VBM does not have the exact BOM there will definitely be problems in the process of becoming a PN Factory. In addition to this, Warehouse stated that if VBM were to become a PN Factory, the BOM should be around 98 percent accurate. The accurate information regarding the BOM is crucial for the company since this document

¹⁹⁸ Rafael Kisel, Purchasing Director, 2003

¹⁹⁹ Hector Nuñez, Head of Process Engineering & Rafael Kisel, Purchasing Director, 2003

²⁰⁰ Kjell-Arne Lindvall, Head of Product Development, 2003

²⁰¹ Pedro Espinosa, Head of Logistics, 2003

²⁰² Pedro Espinosa, Head of Logistics, 2003

includes the list of material, the structure, the part number, how many materials for consumption are needed, where it is needed, and the number of operations or workstations available.²⁰³

Tomas Håkansson, Consultant, argues that it is likely that the BOM quality will decrease if VBM became a PN Factory. This was also stated by PED who said that the future BOM would probably be less accurate than the current one as there would be more pieces to play around with. Moreover, it was stated that there are not that many engineers in VBM that have worked with chassis before, making the situation even more troublesome.²⁰⁴ Nevertheless, in order to get a 100 percent correct BOM for Chassis, you need to copy the exact procedures of VBB. In order to do this, you would need Purchasing, Construction, and Production supplements in VBM.²⁰⁵

5.2.6 Design Change Notification (DCN)

The DCN implementation process has been identified as crucial in the factory systems as the easy implementation of new items will facilitate the continuous production of products. If this process does not work correctly, it will have implications throughout the manufacturing system. This is because the implementations of DCN's are something that involves and impacts many operational areas within VBM. More specifically, it has been shown that the issues and concerns regarding the impact on the DCN process of a potential upward migration to a PN Factory for Chassis lies around the following areas:

- The access to a full BOM for Chassis
- Current DCN Process

5.2.6.1 Access to a Full BOM for Chassis

It is argued that what will be crucial in order to handle the DCN implementation process if VBM are to upgrade its activities, is to have full access to all the Chassis DCN. These are currently handled in Sweden by the Engineering Department but this information will be required in VBM as well, as it will allow them extra time to formulate a plan for when to introduce the

²⁰³ Emilio Torres, Head of Warehouse, 2003

²⁰⁴ Hector Nuñez, Head of Process Engineering, 2003

²⁰⁵ Tomas Håkansson, Consultant, 2003

DCN in the assembly line. This would allow them to put an early notification to the supplier, in terms of their future needs.²⁰⁶ This view is furthermore reinforced by Kjell-Arne Lindvall, Head of the Product Development department, who argues that Beredning “*is the key...*” and the ones really doing all the administration. He therefore argues that they would be in much need of the complete bus specification, i.e. the Chassis specification as well.²⁰⁷ Hence, what is deemed necessary is thus more access to the BOM information so more advanced information about future DCN’s that are in the process of being implemented can be obtained.

Body DCN’s are currently handled through the MFG/PRO system. VBM make the decision regarding these locally as far as concerned with when to introduce these changes and the checking of inventory levels and Call Offs. What will be needed if VBM were to become a PN Factory for Chassis is to synchronise the suppliers and ensure that they are prepared and ready to supply these new changes in order not to stop the production line. This analysis needs to be made locally in VBM, where the decision on activity day is made.²⁰⁸

VBM will furthermore need to tie the day of introduction to both systems (KOLA and MFG/PRO) in order to keep them synchronised. This is simply because DCN implementation requires a lot of data and because parts quickly become obsolete due to new part number introductions. VBM needs to be able to coordinate all these changes and keep the systems updated.²⁰⁹

This is also argued by Mats Lindevall, Global Buyer, who states that, because the design department and the owner of the BOM for Chassis currently resides in Gothenburg, Sweden, they decide all the part numbers that need to be used for a bus and make the decision regarding DCNs’. Currently, it is the role of the Beredning Department in VBB to take care of all these changes and add them to the specification of a BOM for the Chassis. However, if VBM becomes a Chassis PN Factory, they will need a Beredning Department that knows how to deal with the KOLA system where all New Parts are handled and stored.

They furthermore need to ensure that all changes to the BOM are made in Mexico so that they accurately mirror the BOM in Sweden at VBB. VBM can

²⁰⁶ Enrique Rustián, Head of IT, 2003

²⁰⁷ Kjell-Arne Lindvall, Product Development Engineering, 2003

²⁰⁸ *ibid*

²⁰⁹ Enrique Rustián, Head of IT, 2003

make changes to the BOM for the Chassis but in Mats Lindevall's opinion they are sometimes too late in making these. What they need is someone to take care of all the DCNs' in the KOLA system, create a new BOM so that they produce in accordance with the latest specification and include the new part numbers in a complete bus structure, in a similar way as they do in Sweden. Thus VBM will need a well functioning Beredning and a good logistics system that can produce schedules and planned Call Offs.

5.2.6.2 Current DCN Process

According to Rafael Kisel, Purchasing Director, another issue that needs to be taken into consideration is the current process of receiving DCN's and new Part Numbers from Sweden. The process today is very manual and one must ask how this will affect DCN's not raised in Mexico? This issue is relevant as the Engineering Department, responsible for Chassis DCN's is in Sweden and will most probably remain there. It is therefore believed that in order to handle these, a better communication line with them is required as VBM will need to start handling additional Chassis DCN's.²¹⁰

The DCN implementation is a very important and complex issue that needs to be understood before the upgrading decision is taken. Currently, VBM themselves do not believe that they are the best in undertaking this process. What is in their favour though is that only a limited number of options for Chassis variations exist. This is simply in order to reduce the variations and the number of Chassis DCN needed. If this was not the case, or if it changed, the workload of these would increase even more dramatically.²¹¹

When looking at the procedure for introducing new DCN's, it becomes apparent that some problems might arise in the current process. In Sweden the process starts with an Engineer raising a new part number or a DCN. When this NP is released it goes automatically via different systems to the Handle Log of a buyer at the Purchasing department. All this buyer needs to do in his daily work is to go to the Handle Log and identify the new part number. However, in Mexico they don't have these connected systems, which make the work more difficult.²¹²

²¹⁰ Rafael Kisel, Purchasing Director, 2003

²¹¹ Rafael Kisel, Purchasing Director, 2003

²¹² *ibid*

One of the problems the Head of Beredning, Ignacio Aguirre, mentioned is that

“Beredning in Mexico doesn’t know too much about the processes undertaken by other Beredning departments around the world. We don’t know what is happening outside Mexico”.

In VBM on the other hand, every time a DCN is raised, a local buyer needs to check all the raised DCN’s and check all the new part numbers in order to identify the one that is relevant. Once this has been established, all the information related to the change needs to be put manually in the Handle Log. This employee then needs to look into the item of his responsibility, as commodity group divides the responsibility within the department.²¹³

This buyer’s job is then to give an answer as to when the earliest day for this DCN to be ready is and this date will then become the earliest date for introduction. All departments involved in the DCN implementation will investigate as to when the earliest their department could be ready to implement the new part number.²¹⁴ As mentioned earlier in this thesis, a committee meeting will then be set up by Beredning, where discussions will be made regarding the different dates and an earliest date for introduction established.

In addition to this, there are issues arising from the long lead times in getting a Chassis from VBB. As VBM are not keeping track of the DCN’s made in Sweden for Chassis, they are often taken by surprise once the CKD Kit arrives. As a result, there might be the need to make changes to the body as a result of the changes in the chassis. Although the DCN’s are in the KOLA system, there does not seem to be enough time to follow them all due to their sheer number. In order to follow them all, it is argued that VBM would need to appoint people whose only responsibility would be to track these changes. Rather they have decided to follow the Product Modifications (PM’s) and find out what is happening with regard to the changes.²¹⁵

According to Kjell-Arne Lindvall, Head of Product Development Engineering, the implications on the design of the chassis would not be that significant if VBM were to become a Chassis PN Factory. Rather the question will be on how to get the right parts together at the right time. In addition to this, it is

²¹³ ibid

²¹⁴ ibid

²¹⁵ Kjell-Arne Lindvall, Product Development, 2003

important to be careful about validation when implementing chassis changes if VBM decides to buy from a local supplier. A situation might then arise where a DCN is decided in Sweden but the local supplier not ready to deliver. However, if VBM buys from the current suppliers, then this would not be a problem.

It is also argued that because VBM already has made a Mexican specification for the chassis when placing the order for a CKD Kit, no additional changes should have to be necessary when the CKD Kit arrives. What might need to be done is for VBM to order all the parts and coordinate with DCN changes from Gothenburg.²¹⁶

The coordination between departments is also an issue at VBM. Looking at the target times for DCN implementation it became apparent that the target time for this implementation differs substantially between Process Engineering, Logistics, Purchasing, and Beredning. For Process Engineering and Beredning it is one week, for Logistics it is four weeks and for Purchasing it is six weeks. Currently, there are difficulties in reaching these targets in more or less all departments.

These delays are believed to occur due to a variety of different reasons. However, it is believed that three main reasons can be identified. One can be that there are problems with the information from the Engineering Department or Process Development Engineering Department in the DCN process. When this information is not 100 percent correct there will be problems in the rest of the implementation process. A second reason can be that new material that will be used in production is not supplied or complied with by the supplier. Another reason could be that it takes too long to find a good supplier who can provide VBM with the correct material needed in order to make a change.²¹⁷

5.2.7 Human Resource Needs

Human Resource is a significant part of any company. When a CKD Assembly Plant upgrades its operations to a PN Factory, the people involved in the process will probably need some kind of support, reinforcing that HR is important. This does not only mean hiring new employees to keep up with the current procedures, but it also requires educating and preparing the present

²¹⁶ *ibid*

²¹⁷ Ignacio Aguirre, Head of Beredning, 2003

employees for this change and training new people in the company in order to work towards the same goal. Because a PN Factory requires more responsibility and control from VBM, this need is an essential factor to look into.

Working as a PN Factory for Body parts has demonstrated that more workload is required and careful considerations for the decisions taken are needed. Moreover, the increase of manoeuvrability in their daily work has shown to play an important role. For Chassis parts, the situation will not be much different. All these factors will also become evident and VBM ought to be prepared for this development. By looking back to what happened when VBM became a PN Factory for Body could now help them in becoming a PN Factory for Chassis. Past mistakes and communication problems could be avoided if VBM takes the past procedure as an example. The main issue areas are thus the following:

- Additional personnel needs
- Education and training

5.2.7.1 Additional personnel needs

After undertaking several interviews in the Plant, it was clear that the departments in need of additional Human Resources are, Logistics, Process Engineering, Traffic, Warehouse and Beredning.

Logistics is seen as a critical and crucial department when upgrading to a PN Factory. This is why it might need to include additional human resources. This department is in charge of putting the different part number codes into the local system. Today they are including only one chassis code into the system but with a PN Factory their workload will definitely increase as they will have to include around 1500 part numbers. This can naturally be done with additional people or by improving the local system.²¹⁸

The Process Engineering department will also need additional human resources. They will need to be careful while putting the specifications of the material in the system and when creating the BOM. With a PN Factory Process

²¹⁸ Pedro Espinosa, Head of Logistics, 2003

Engineering will have to be more specific in their duties hence additional control and people is needed to accomplish this task as accurate as possible.²¹⁹

In addition, Traffic will need more people to handle the customs and the tax issues. The amount of people required to handle the workload will depend on the amount of new part numbers. As mentioned before and since there are more part numbers to be declared and the customs clearance process is more complex and possibly takes more time, the customs broker might feel the need to include additional employees to work for VBM. This is an issue that should be carefully negotiated with each customs broker.²²⁰

Since the company will start receiving more part numbers that will arrive at different times, the Warehouse department will also need more people for the reception of the material from all the suppliers. Nonetheless, not only people will be needed to accomplish this task, also more equipment will be required to handle the situation more efficiently.²²¹

Finally, the Beredning department stated that they might need additional people to handle the DCN changes, but they will only be certain after the department have established what exactly will change in their daily work. If Sweden is going to continue to provide VBM with the design and changes for chassis, Berednings work might not change much and thus they wont need more people, but again this only depends if the work changes or not.²²²

On the other hand, Purchasing, Finance, Production, IT and Product Development Engineering are the departments that will not change their way of working thus they will not need additional human resources. The workload will increase but there will not be a need for more people. For example, Purchasing will only need to know who the new suppliers are in order to include them in their supplier database and Finance will need to know what the payment conditions with these new suppliers are in order to be prepared to deal with new currencies.²²³

²¹⁹ Hector Nuñez, Head of Process Engineering, 2003

²²⁰ Arturo Alanís, Head of Traffic, 2003

²²¹ Emilio Torres, Head of Warehouse, 2003

²²² Ignacio Aguirre, Head of Beredning, 2003

²²³ Roberto Almaguer, Global Buyer & Fernando Bastida, Controller, 2003

5.2.7.2 Education and training

It is argued that the expertise to upgrade to a PN Factory already exists within VBM as they have undertaken a similar process for its body activities. It is therefore believed that using the same procedures as before and by using MFG/PRO to control these issues, it will be enough to make the transformation in chassis as well. Nonetheless, monetary benefits to undertake this project need to be established in order to make sure that this upgrade process is worth accomplishing.²²⁴

It is also argued that VBM already has the knowledge to work with and knows how to undertake this change. The risk or the challenge that VBM could have lies in providing adequate training for the employees at VBM.²²⁵ Good co-ordination between all the departments is required for the upward migration to take place efficiently. This is due to the fact that co-ordination will consequently affect quality.²²⁶

5.2.8 Others

In our research we also identified three additional issues that were deemed important to take into consideration. These are:

- Local integration
- Physical Space
- Scheduling & Prognosis

5.2.8.1 Local Integration

According to Rafael Kisel, Purchasing Director, VBM is more or less ready to become a PN Factory for Chassis if this involves buying material from the same suppliers VBB is currently dealing with in Europe. However, if the upward migration to a PN Factory is to include local integration with local suppliers from Mexico, the situation will become more complicated. It was stated that to successfully integrate VBM with local suppliers for Chassis Part Numbers, could take the company several years to accomplish due to

²²⁴ Enrique Rustrián, Head of IT, 2003

²²⁵ *ibid*

²²⁶ Ignacio Aguirre, Head of Beredning, 2003

homologation and quality issues related to the final product. It would have to be established whether issues like safety, which is an important core value or problems with maintenance can be dealt with. If VBM wants to integrate with local suppliers, they will need to establish what part numbers can be competitively bought in Mexico. If no competitive suppliers can be found, the purchase of this material will have to be undertaken from somewhere else and local integration will be jeopardised.

According to Claes Göran Persson, CKD-Operations and Projects Manager at VBB, if Volvo Bus de Mexico continues to work with European suppliers, the costs could stay the same. But if they start using more domestic suppliers, then costs will be reduced. This is mainly because there are lower production costs in Mexico, and by avoiding the importation of material; the transportation costs will naturally also decrease. It is furthermore believed that VBM will never be 100 percent integrated with local suppliers as some part numbers such as engines, axles, gearbox, frames and transmission will always be delivered from Sweden. However, what might be possible is the local integration for Part Numbers such as fasteners, rubber, hoses and tubes amongst many other low cost quantity items.²²⁷ This statement was also shared by the Production Director, José Martínez.

Rafael Kisel, Purchasing Director, further stated that integration with local suppliers needs to be a total different project from the CKD Chassis Assembly Plant upgrade. Although it would be possible to start to run the local integration project at the same time as the upward migration to become a PN Factory, it has to be acknowledged that it will probably take a longer time to complete and implement. The company would probably have problems if they start mixing these two distinct concepts. This statement was made because it is argued that it is possible to have a PN Factory without local integration with suppliers.

José Martínez, Production Director, had a slight different opinion regarding the time to implement local integration. He stated that local integration for chassis is possible and that it could take three or four months to find a domestic supplier for each part number required. Of course it will also depend on the complexity of the part number, but he thinks that most of the part numbers are available in Mexico.

²²⁷ Rafael Kisel, Purchasing Director, 2003

5.2.8.2 Physical space

According to Emilio Torres, Head of Warehouse, if VBM upgrades its operations to a PN Factory, the Warehouse department would need more physical space in the Plant. Becoming a PN Factory, would not only require more space to handle more part numbers but they would also need more truck-lifts, probably more electronic reading systems for the bar codes like scanners, and three more ramps to offload the material and three more places for containers to receive the goods. It is estimated that they might need 30 percent more of everything. Currently, Warehouse is managing about 2,900 different parts for body. However, it should be acknowledged that body parts take more space than chassis parts, because they are bigger in size and volume.

At the moment part numbers for chassis are stored in an open area. If VBM decided to become a PN Factory, Warehouse will need to store all the material for chassis in a closed area. This is to ensure that material does not get lost and in order to control the in and outflow of the material in a more effective manner. Hector Nuñez, Head of the Process Engineering department, agreed with the Warehouse's position. He said that one of the problems VBM might face when becoming a PN Factory would be to find enough room to store the material. He indicated that VBM would need around 20 percent more space and the issue is whether they are ready to make this investment. Both the Warehouse and Process Engineering departments agreed that VBM has enough space to put this new material, the question or problem would be making the investment. In order to get some kind of investment for physical space, VBM will need to have a good justification.

5.2.8.3 Scheduling & Prognosis

As mentioned earlier there are concerns over the current scheduling and prognosis procedures at VBM. According to Mats Lindevall, Global Buyer, the lack of access to the full Chassis BOM often leads to VBM being late in sending schedules to their suppliers. It is his argument that VBM will need a better scheduling and prognosis system in order to be able to function well as a PN Factory for Chassis. Currently the schedules are done manually, based on the BOM in the KOLA system, created by the Engineering Department. This is in contrast to the way it is done in Sweden where forecast is made on historical data and order queries, amongst many other things. As a result of this, and

because lead times for European suppliers are long, there might arise problems when placing large orders, not based on accurate forecast. Consequently, suppliers might then face difficulties in delivering the quantities required. Therefore, it is of significant value to have a well working prognosis or scheduling system.

As there will also be a need to start managing an additional number of European suppliers if VBM was to become a PN Factory for Chassis, the access to a proper scheduling and prognosis system increases. The reason for this he argues is that suppliers are used to receiving accurate schedules helping them to reach the evaluation criteria set by Volvo and to deliver according to the schedule sent. It can therefore be expected that the supplier will require the same scheduling information from VBM in order to live up to the delivery standards expected by Volvo. According to Mats Lindevall, this is a global issue that needs to be dealt with locally. If VBM does not have an adequate scheduling system in place, they might face considerable problems. Currently, many Logistics departments at Volvo are working with schedules in order to reduce lead times and lower stock within and at the suppliers. If VBM were to give shorter notice than these suppliers are expected to, the supplier might not have the possibility to fulfil the quantities required at the specific date. As a result of the inadequate scheduling and the failure of the suppliers to deliver according to it, VBM might experience a stop in the production line which will incur them great costs.²²⁸ This view is shared by Mirsad Sela, Project Manager CKD-Operations at VBB.

²²⁸ Mats Lindevall, Global Buyer, 2003

Part III – Analysis, Conclusion & Recommendations

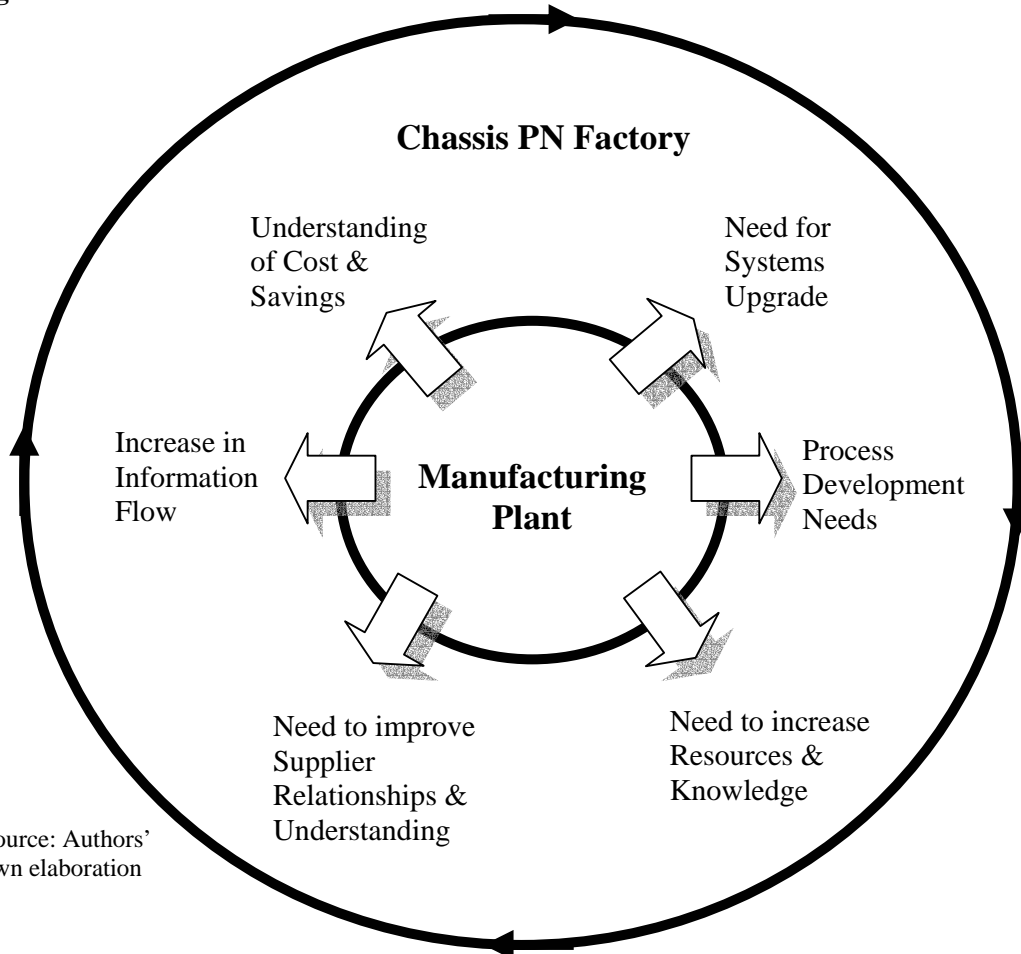
6 Analysis

In section 6.1, we will be comparing, evaluating and analysing the findings of the empirical investigation, and thereby obtain a better understanding of the issues and concerns discussed. We will be able to demonstrate why they arise and thereby also establish what is required to overcome them. In section 6.2, we will analyse what the impact on the competitive priorities will be.

6.1 Analysis of the Issues and Concerns Identified

The model below illustrates the outcome of the analysis that will follow on the issues and concerns of VBM's operational areas and why they exist. This will also give us an understanding of what is needed in order to overcome them. These things will be discussed in more detail below.

Figure 8 Reasons behind the rise of Issues and Concerns



Source: Authors' own elaboration

6.1.1 Costs

Something that seems to not have received enough focus at VBM is what the impact on future sales volumes will be on the savings that can be made and the costs that will be incurred if VBM was to become a PN Factory. The desirable production volumes that should justify such a change do not seem to be clearly defined. Although VBM might have the right production volume at the moment, it is important to try and forecast what the future sales and production potential will be. By this, it will be easier to justify the potential strategic migration as the savings that arguably can be made should increase the more production is augmented.

In light of the limited knowledge as to what volume should be desirable to have in order to become a PN Factory and what the potential future sales volumes are, it needs perhaps to be questioned as to what basis the decision to upgrade the Plants has been taken. Although there seems like there is a general agreement that there are savings to be made, these seem to be made on speculations and experience rather than hard facts. Not knowing the exact cost breakdown of a CKD Kit could also make it more difficult to know where exactly these potential savings could be made. Hence, the lack of this information could at a later stage proven to have been vital.

Having the exact cost breakdown of a CKD Kit, would arguably also make the work of several operational areas easier. This would be specifically so for the Purchasing department which then would be able to easier identify what suppliers they are dealing with at a reasonable price and where further negotiations would need to take place.

Furthermore, it needs to be understood where the savings will be made and where the costs will increase. Being a low cost country, there are potential savings to be made in wage costs and employees. Nonetheless, one must establish whether the increase in resources and personnel will require more white collar or blue collar employees.

We would like to argue that the greatest benefits can be obtained if the potential increases in resources need to be taken place on activities carried out by blue collar employees as the costs and wages of hiring white collar employees not necessarily will mean that so much savings can be made. Hence, it becomes

important to understand where savings are possible and where VBM costs will increase, and in what areas. Knowing the exact costs breakdown would also help VBM in understanding what additional services are included in the CKD Kit apart from what is now visible or known.

Not knowing the exact costs breakdown has furthermore implications for the ambiguity that exists over the costs for surcharges. It seems like this is an area that has been given different importance in the potential upgrade the Plant. As some argue that the potential to make savings on these will increase, other argues that this cannot be the case. Even if VBM was able to negotiate lower overhead costs and have a lower charge this might not be to prefer due to internal VBC reasons. A reason for this is that in such a case, the reflection on profitability of VBM would not be accurate and this could make profit comparison between different Volvo Plants more difficult. Thus, a situation might then arise where these other Plants could start arguing that they should not have to cover these costs as well, costs which might even increase for them as they will have to compensate for the part not paid by VBM. Such a situation could have negative implications throughout the whole Volvo Bus Corporation.

VBM is currently operating without a complete part number breakdown of the CKD Kit. The implications of this for costs could also be negative as having to import part numbers individually from different suppliers could increase the customs taxes and other costs as well as delivery costs. Hence, it is thought that there currently exists a lot of ambiguity and lack of clear understanding as to what the exact cost breakdown of the CKD Kit is, as well as what particular part numbers are effected.

As much of the information needed to provide a good understanding to the issues above seems to be dependant on the right communication flow accruing between internal and external operational areas, some additional focus to align these areas closer to each other might be to prefer. It seems for instance that many of them are quite dependant of information and details supplied by other departments but that this information is not always delivered in accordance to their needs. This might be an even bigger issue when talking about the CKD Kit and the cost breakdown. This seems to be dependent on the willingness of VBB to supply this information as they are the ones closest at hand in knowing the details.

6.1.2 Systems

A need for improvements in the systems and the process currently used is required and identified by many of the operational departments spoken to. Whereas this relates to the current systems and the processes for using them, we would like to argue that it is important to question whether it is enough to develop the current processes and systems used or if there is a need to develop new ones altogether? Continuous improvements and development of systems processes have, and are taking place, but these seem to be based on developing the existent processes. However, with the proposed transfer to the SAP system, there might be a need to undertake a more full scale investigation on how the systems processes will need to look in order to be better prepared for this change. This would furthermore allow VBM to better align their systems process to those used in VBB, who arguably has the best knowledge of how to operate as a PN Factory for Chassis.

Taking into consideration the argument of CIO Thomas Fransson, that VBM has not completed the process of implementing the right systems procedures for Body Building, it should also be questioned whether VBM will be able to undertake such a major change at the same time. What is needed is of course for the two distinct assembly and production parts to be aligned as much as possible in terms of systems processes and procedures so more efficiency in the combined process can be obtained.

In addition to this, and as mentioned earlier, operational areas within VBM are still quite dependent on information flows from areas within as well as outside the Plant. This furthermore reinforces the fact that systems processes and procedures as well as the systems themselves must be better aligned so that a better understanding and the same language can be used. This will undoubtedly make the problem solving procedures easier. The above need can be reinforced by Beredning and the Traffic department that argue that much of their work still needs to be undertaken manually. This could arguably be taken as further evidence that the current processes and procedures used are not adequate but might have to be overhauled and rethought.

The needs to have systems that are accurate and contain the right detailed information also have implications for the production line of course. As a situation currently prevails, where the internal systems used as well as their

connection to broader Volvo systems seem to have a problem, there is a problem with deviations in these systems. These deviations have a particular negative impact on the production line. The reason for this is that the production line is working with material that is “pushed” to them by Traffic as new orders come in and material is needed. However, the efficiency of this way of working is all dependent and based on the information and details held in the systems and its accuracy. If this information is not correct, it will have implications for the production line as they might be faced with a situation where they will receive the wrong material or have missing parts. Hence it is important to use better aligned systems that are frequently updated or automatically fed with the right information so that the errors can be reduced. The question is whether VBM has the right systems and processes currently to ensure this?

As the information required for VBM to undertake their production activities is not complete in all the systems used, they need to complete this by drawing on information from many systems that need to be complemented manually. This is particularly in reference to the important BOM that is required in the whole bus production process. This will of course have implications for the accuracy of the information held as human errors and workload might for instance lead to deviations. Add to this the fact that if VBM was to become a PN Factory for Chassis, the information need would increase dramatically and more information in the local systems would be handled. This reinforces the need to have systems that are more aligned and increase the automatic information flows or even waiting for the more advanced fully integrated systems SAP to be implemented.

Nonetheless, looking further into the future and the issue of local integration, the implementation of SAP might be questioned. Could a situation arise in the future after the implementation of SAP, where difficulties to communicate with more local suppliers would arise?

6.1.3 Suppliers

As mentioned previously, the systems used at VBM are not facilitating the information flows in the daily work. Systems must be improved, considering that the systems are not ready to manage all the information regarding suppliers. With the new situation of becoming a PN Factory, this issue will

increase as each operational area, particularly the Purchasing department, will have the obligation to handle an increased number of suppliers in the supplier database. For this reason, it is essential that the supplier database be completed before VBM upgrades its operations. Purchasing must be careful when including new suppliers into the system because later it is that information which will be used by the rest of the organisation to base the decision on who to work with. Thus, it is argued that adequate systems will also lessen the workload in many departments and improve the relationships with suppliers.

One of the main differences of working as a PN Factory will be the need to have direct contact with suppliers. The importance to sustain a good relationship with them is thus a crucial issue to take into account. It can be argued that the suppliers' evaluation tool or model that the company should be applying to each supplier is perhaps not used to a large extent. Several complaints between the different operational areas regarding suppliers have been made, thus it seems that no real update is done to calculate the quality each one is providing to the company. Everyone knows about the situation but no action is taken to solve the real problem behind this issue. This is perhaps a big concern when upgrading the operations of the company to become a PN Factory. If the evaluation is not done correctly now it could get worse with time.

All the above discussion is due to the fact that if VBM were to become a PN Factory, the issues regarding quality, delivery times and missing parts could increase. At the moment the company is backed up by VBB, and might therefore, not really put as much effort to combat the problems they have with some of their suppliers in Europe. This attitude is very concerning. Since VBB is doing the direct contact at the moment, VBM seems to be more reluctant to look deeper into the subject. It seems like there are some issues in terms of the way which the relationship with the new suppliers should be handled and how they should be evaluated. This might be attributed to the insufficient use of the existent tools and systems and might imply that a new way to undertake this process might be required.

However, when dealing directly with European suppliers not only language issues might arise, but the stipulation of contracts could differ for each country. The kind of contract the suppliers have with VBB will mostly differ in terms of delivery. As explained earlier, suppliers are making a local sale with VBB at

the moment. The direct delivery of goods to VBM will thus mean a more complex situation for suppliers since they will be faced with a direct exportation procedure. Whilst some suppliers might be familiar with exporting procedures to Mexico, some may not, which in turn can lead to problems in the production line and delays. This could imply that it will be very important to provide sufficient knowledge about this change to the suppliers before undertaking the upgrade process in order for negotiations to flow smoother and eliminate the risk of missing parts. In addition, accurate delivery times are essential for a PN Factory, especially for the Production department. With a PN Factory, it is discussed that lead times would decrease as suppliers are sending the Part Numbers directly to VBM's Warehouse, making VBM obtain more control and increase their flexibility.

The additional workload for many departments with the increase contact with suppliers will also have an impact with the costs the company will have to undertake. More visits to suppliers will have to be made, better systems applied and more people will need to be involved. It seems like the access to updated and correct information about the new suppliers have given rise to some of these concerns. Hence, it seems like VBM is counting on the support of VBB to obtain this information. The concern of VBM lies around the fact that they believe that the more specific the supplier information is, the less unnecessary work will have to be undertaken in the future when dealing with the new suppliers. This will also facilitate VBM's work and reduce the risk of human errors and their ability to apply the correct tax codes in the import process.

Another interesting subject when talking about suppliers are the different purchasing agreements. As mentioned earlier, the contracts might change. The combination and co-ordination of partner companies can have an important impact on future purchasing agreement negotiations. Since more responsibility will lie in VBM if it were to become a PN Factory, any help to obtain better deals with suppliers will have to be acknowledged.

6.1.4 Process

Although some departments mentioned that their way of working will not change if VBM were to become a PN Factory, the processes in most of the operational areas will differ from today. Dealing with more part numbers, an increased number of suppliers, and applying the correct FTA and taxes are just a few important factors to consider in the day to day processes.

At VBM some concern seem to arise from a belief that not all operational areas are ready to handle the upgrade to a PN Factory for Chassis, and that they feel that they would require different amount of time for this. It seems like the issue evolves around the difficulties to establish a breakpoint between the readiness levels of the different departments for the upgrade of the Plant. As many departments feel that there currently are too many problems with the way current processes and procedures are carried out, a premature implementation and upgrade to a PN Factory for Chassis could have negative impacts throughout the organisation.

These concerns might furthermore have arisen from a lack of understanding of how exactly the upgrade would affect each department. By not knowing what is expected from them, the different departments do not seem to be confident of how they can influence and be affected by the potential upgrade to a PN Factory for Chassis.

The creation of a correct BOM was also seen as an important issue for having an adequate flow in the process of all the operational areas. The process will differ from case to case depending on the accuracy of this BOM. This is because all departments are inter linked with each others daily process, if the Engineering departments get the structure in the BOM wrong then this will have a crucial implication in the process of the rest of the departments as well.

Taking a look at the role the Logistics department has in VBM and all the different procedures they are undertaking to accomplish their daily workload could sum up to future problems if VBM becomes a PN Factory. There must be a good reason behind the Logistics department decision to over pass the normal process steps that they should be respecting. It seems like this decision can be attributed to a feeling of not having the appropriate tools, systems, and process

to undertake the work in a proper way. There also seems to be a belief that the necessary support is not always given from other operational areas, hence “forcing” them to bypass the routines and procedures set out for them.

The general process of material handling and missing parts is also a special concern in many operational areas. With a PN Factory the arrival of more part numbers to the General Warehouse would mean that VBM must improve the current control process they are using. Currently, it seems like the current control mechanism for this is not sufficient and needs to be improved. Furthermore, although a PN Factory requires more control in the Warehouse, VBM will also increase their flexibility in terms of receiving the material when ever they need it. The storage, assortment and the provision of the material to the production line will depend on VBM to a larger extent. It is therefore, important that the adequate assistance is given to the Warehouse in order for them to handle the new situation and process in a more efficient manner.

6.1.5 Bill of Material (BOM)

As mentioned previously the BOM is an important issue to take into consideration, as working with a correct BOM will probably have a direct impact on the costs. Many departments depend on the BOM for their daily work and when upgrading to a PN Factory, the necessity of working with a correct BOM is going to be crucial. At the moment problems arise when this BOM is not 100 percent accurate, since this will lead each operational area to compliment the data as best they can. It will depend on the departments’ ability to get the information closer to reality.

Even though experience and knowledge play an important role in this process, many times these two factors are not sufficient and there are still many errors at the end of the day. The problem also lies in the fact that all these errors can not be seen until the bus is being constructed. Of course this is alarming, since VBM can not afford to stop the production line. The different operational areas seem to be using a different percent of accuracy which also leads to confusion and more problems within the process. With a PN Factory, the augmented number of part numbers will increase the possibility of more errors to occur since there will be more part numbers to play around with. This gives rise to concerns about the accuracy of the future BOM required in the production of a bus.

Additionally, the BOM for Body is not being handled adequately by the company. VBM owns the BOM for Body, and thus should be able to deal with this situation more cautiously. If VBM were to become a PN Factory, the BOM for Chassis will have to be treated carefully as well. The limited use of the KOLA system to create the BOM is one of the major problems. VBM seems to be creating a new BOM for every variant and every order, making it more obvious that they are not using the information at their disposal in the systems.

As VBM is receiving a “black box” for chassis, and the ownership of the BOM for Chassis is in hands of the Engineering department in Sweden, there are doubts about whether the company can become a PN Factory for Chassis before this issue has been resolved. This is of course a result of the feeling that VBM does not have access to the full chassis information in the systems, hence leading to a concern that the handling of Chassis Part Numbers could become very complex. It is therefore believed that even if the BOM for Chassis will continue to be owned by Sweden, VBM would need to be able to obtain more information from the systems. There seems to be a fear that the difficulties the firm is having by not owning the structure and not obtaining all the knowledge necessary to create a correct BOM will probably continue and might even become more of a burden if becoming a PN Factory for Chassis.

Moreover, it should be mentioned that if VBM decides to become a PN Factory for Chassis, it must also be very careful with the general bus structure. Becoming a PN Factory would mean that VBM will start owning the structure of the bus which will increase their responsibility with regards to all the new items involved in the construction. The concern seems to arise over whether VBM is ready to take on this responsibility and the need to find adequate suppliers in the future. The current problems with the body process, operating as a PN Factory, has arguable influenced the departments belief of whether they are ready or not.

6.1.6 Design Change Notification DCN

Throughout the empirical data gathering process, it was highlighted that the importance of having a correct DCN procedures, the way by which new material and part numbers are introduced, should and could not be ignored.

The issues and worries currently within this area seem to be a question of not having the right procedures. Therefore, there seems to be a lack of information and understanding as to how the process will need to change if VBM became a PN Factory for Chassis. In the own words of Ignacio Aguirre, it was stated that the Beredning department at VBM had very limited knowledge of how the process looked in other VBC plants.

This might be a problem as it could imply that the insight in how to work with DCN changes is very limited as the experience of working with these changes is also very scarce. This could have severe implications for the ability of VBM to handle the increase in DCNs' that might occur. The issues and concerns with the potential future DCN implementation has arguably arisen due to systems issues as well and the access to BOM and the Chassis specifications available for VBM, and the way this information is received.

In a similar way as the supplier issue discussed earlier, this situation can be attributed to that not enough "interest" has been taken with regards to chassis implementations as the process has been taken care of by VBB. In a sense there has been a situation of working with a "black box" where everything related to the chassis was taken care of prior to the arrival of the material to VBM.

6.1.7 Human Resource Needs

The concerns with regards to human resource needs could be attributed to the lack of experience of dealing with Chassis Part Numbers and the fact that not enough knowledge to operate within the current processes and procedures set out is existing. Having problems operating with current procedures means that there is a concern about what will happen if even more pressure is put on the operational areas in terms of dealing with Chassis Part Numbers. As a result, the believed need for human resources is apparent in most departments as they furthermore think that the current systems and technology at VBM cannot be used to compensate for the increase in workload. This can also be a result of the lack of understanding as to how exactly the departments will be effected and what the impact on their workload will be.

However, if more personnel should be included, a closer look at the effect on total savings should be taken. As mentioned earlier in the costs section, contracting blue and white collar employees will have different implications on

the costs. Hence, the reasoning behind becoming a PN Factory for Chassis has been questioned as well. There are also concerns arising from the fact that problems with the Body PN Factory are still not resolved. If the current knowledge within VBM is not adequate to handle this, there are fears that starting to implement Chassis Part Numbers to the current system will have severe implications.

The fact that many employees worked with the company before its acquisition by Volvo could also give rise to some future issues. There seems like the learning process and new way of operating more like a European company is not yet completed. This has led to a feeling of not being able to face up to the expected demands and increased responsibility that operating as a Chassis PN Factory arguably will mean. What might be the problem is that there currently are divided opinions on what the best way forward for VBM is.

In all, it can be said that questions have been raised with regards to VBM's readiness level in terms of knowledge to handle Chassis Part Numbers and the ability of employees to work with the current processes and procedures in an efficient manner. There are beliefs that perhaps not enough training has been provided for this and that the lack of understanding of best practices could impact VBM's ability to operate as a PN Factory for Chassis. With regards to the need for additional human resources and an increase in knowledge, some department seem to be anxious with the company's ability to pull in the same direction and with having the required knowledge to do this.

6.1.8 Others

The situation with local suppliers is a special issue which needs to be carefully evaluated if VBM were to think of local integration in the future. The investigation has shown that VBM's current local suppliers for body have worked with the company for several years. Most of them have not been really assessed as to being good or bad suppliers, since suppliers had been chosen by the old company called MASA. By just obtaining the same old suppliers, VBM might have done a big mistake.

Conflicting opinions regarding VBM's ability to integrate with local suppliers in the future has also been expressed. This is arguably because the current Supplier Evaluation Model is not deemed sufficient, or not used correctly to

separate poor suppliers from the good ones. Hence concerns with regards to VBM's ability to integrate with local suppliers in the foreseeable future have been raised.

The discussion on whether VBM should become a PN Factory has mainly concerned the issues and problems that might arise in processes and procedures. However, it is important to remember that if VBM were to become a PN Factory for Chassis, it must also take care of the storage issue. Having an additional 1500 part numbers to look after will not only have administrative effects but there are also control and storage issues to consider. Where will all the storage be placed and how will it be controlled and monitored. This is an issue which does not seem to have been attributed enough consideration.

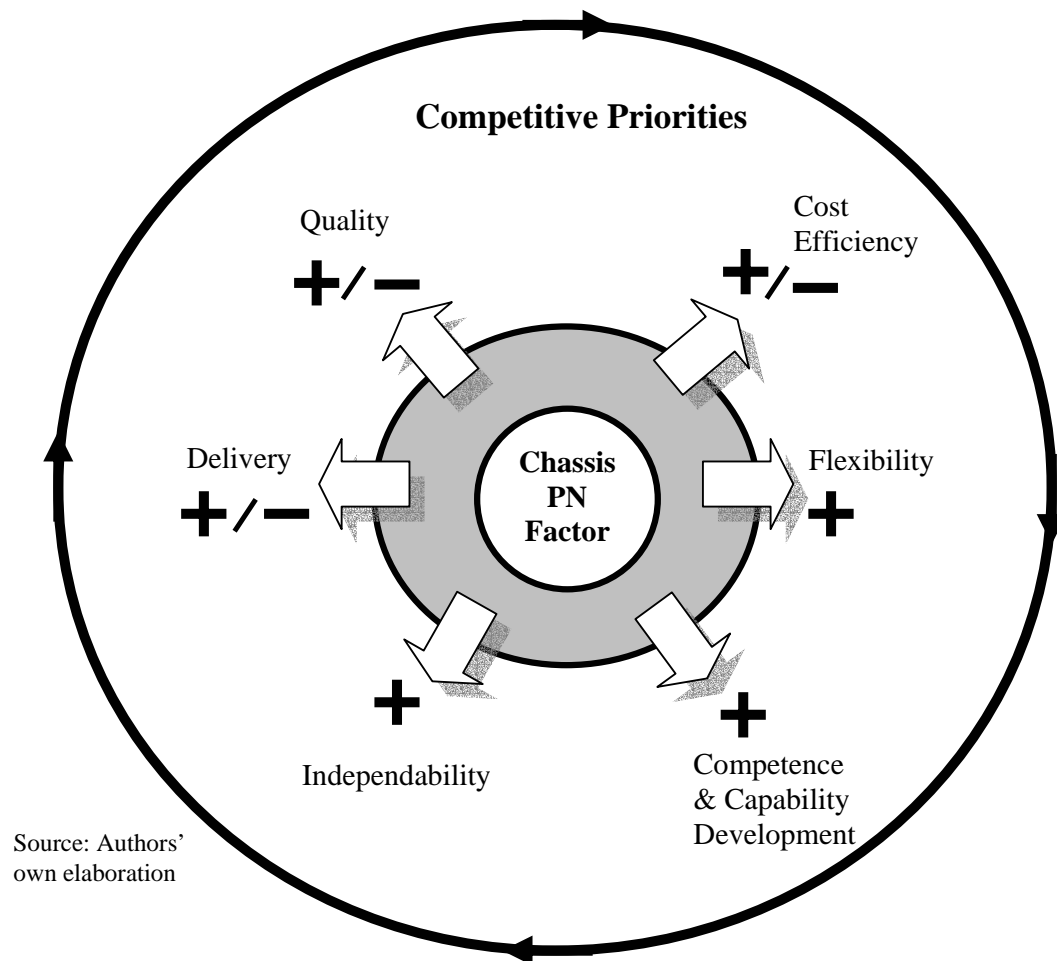
However, as it is unlikely that part numbers will start arriving all at once, this is an issue that perhaps can be deferred. This will only become an issue when such an amount of Part Numbers are taken out of the CKD Kit and started to be bought directly from the suppliers, hence becoming large in numbers. In addition to this, it has been argued that Chassis Part Numbers probably will have a faster rotation in the Warehouse. This leads to the storage issue perhaps not being as crucial at the moment.

The issue of the not having the adequate procedures for prognosis and scheduling can probably be linked to the systems issues as this arguably also is a result of not having the right systems in place. Thus, we believe that because VBM does not have the full BOM information regarding the Chassis, the scheduling progress cannot be correct. Not being able to make the right schedules could have an impact on lead times and costs as well as it increases the likelihood of missing material due to incorrect scheduling and prognosis being made. Hence, this is an issue that needs to be kept in mind.

6.2 Analysis of the impact on competitive priorities

After establishing the main issues related to the upward migration of VBM's Chassis operations to a PN Factory and why they have arisen, we can now identify how the upgrade can influence the six competitive priorities. This corresponds to the next step in our conceptual model and will also help us answer the fourth and last sub question in the problem formulation. We have already looked into the operational areas deemed to be important and have identified the main issues. Now we will recognise their impact on Cost Efficiency, Quality, Delivery, Flexibility, Competence and Capability Development and on Independability. As can be observed in the figure below, we think that all competitive priorities are interlinked with each other. Depending on the impact the issues previously identified will have on the operational areas, and the required effort to solve them will strongly affect the outcome and final upgrade of VBM to a PN Factory.

Figure 9 Impact on Competitive Priorities



Source: Authors' own elaboration

6.2.1 Cost Efficiency

Since the Cost Efficiency will impact on the competitive level a manufacturing plant can have in the short and long term, the analysis and achievement of this should be an ongoing process. At VBM there were several concerns that were highlighted in relation to cost efficiency.

The long term effects on cost efficiency by becoming a PN Factory are by us believed to be positive, although this issue seems to be surrounded by some controversy. It has been highlighted that although there is a general understanding that there are savings to be made, not enough focus seems to have been given to the potential increases in costs that the company might incur.

Not having enough understanding of what and where the exact savings can be made will arguably make it difficult to understand where to direct effort and where to operate with care. Nonetheless, the overall impact on cost efficiency of becoming a PN Factory should be positive. This also relates for example back to the notion of flexibility and that lead times should be reduced. It also needs to be taken into consideration that tariffs on imported vehicles have been abolished and further negotiations on the tariff elimination of auto-parts are taking place. Full liberalisation with Europe regarding imported vehicles is scheduled for 2007 making the imports to Mexico more cost efficient. In addition to this, having greater control and choice in the selection of suppliers furthermore enforces the ability to be able to respond to none adequate supply of material.

The effect on cost efficiency is also arguably impacted by the result that the upward strategic migration would have on competence and capability development. By increasing the knowledge, understanding and the general expertise of the employees of VBM, they will become more efficient in their work and could also start taking advantage of economies of scale in many activities. Thus, the impact that becoming a PN Factory will have on lessening the dependability of VBB can also influence cost efficiency. Not only will the direct and indirect costs be reduced, but this will also lead to a broader supplier base that then will have to compete for the right to supply to VBM. This will allow VBM to source the material from the most cost efficient supplier no matter where they are located.

Hence, it is our belief that the effect on cost efficiency of becoming a PN Factory for Chassis is dependent on several factors such as having established and reached the right production volume, knowing exact where most of the savings will incur, and also knowing what exact additional sources and investments are needed.

Once this is established, it will become easier to facilitate the upward migration and take advantage of the reduction in costs that are related to the suppliers used, the potential reduction in overhead costs, and the shortening in supply chain by bypassing VBB. It should be considered for example that in Mexico City distribution costs area arguably low, and that Mexico as a whole has been highlighted as a cost-effective export base for many years.

Nonetheless, the exact impact on Cost Efficiency cannot be established until a better understanding of what the current costs are and where savings can be made. This will of course also influence the understanding of where additional investments and costs will be incurred.

In conclusion we believe that becoming a PN Factory will affect the notion of **cost efficiency** in the following ways:

- Will probably lead to an overall increase in direct costs depending on the additional resources that are needed to handle the activities of a PN Factory.
- Should decrease the indirect costs but this is dependant on VBM's ability to reduce current global surcharges
- Should affect production related costs by providing a better control of the material flow in the long run.
- Would also lead to lower costs of production depending on the prices that can be negotiated with new suppliers.
- Could lead to more inventory costs but this can be reduced by a higher rotation of goods used.
- Will allow a larger supplier base which will have to compete against each other for the right to supply VBM.

- Will increase flexibility in the case of missing parts and inadequate quality, allowing VBM to respond faster to threats of production line stops.
- Will allow VBM to further develop their expertise in handling the different activities involved in the production of a Bus, hence impacting the efficiency by which activities are undertaken.
- Will abolish/reduce the profit margin for a CKD Kit currently paid to VBB.

6.2.2 *Quality*

The Quality effects of becoming a PN Factory are believed to be positive in the long run. If VBM is to use the current suppliers used by VBB there should not be any difference in the quality issues experienced today. However, in the long run it must be ensured that adequate procedures for supplier evaluation and selection are established. This relates specifically to the notion of local integration where local suppliers will be used for the supply of production material. Not only national suppliers will be approached but as mentioned previously in the empirical chapter, Mexico is the world's ninth largest exporter of vehicles and hosts a majority of international suppliers as well.

The quality issues currently existing in VBM could also be reduced if VBM became a PN Factory for Chassis. By having to deal directly with the suppliers, more control will be needed and if this is achieved, quality issues can be more easily handled.

Operating as a PN Factory will arguably also be positively influenced by the access to a full BOM and chassis specification which really are a prerequisite for this. This is perhaps not related to the quality of the material as such but will ensure greater quality in the process flow and the flow of material. Having access to more correct information will have enormous effect on quality and the reduction of quality issues in both process and materials. So to put it mildly, if the BOM has a high level of quality, then the important DCN will follow the same pattern, which will ultimately lead to increased quality in the whole bus production process.

Overall, we would like to argue that the notion of increased Quality is tightly related to the access of accurate and timely information. We believe that in becoming a PN Factory for Chassis, the access to this information will increase, thereby positively affect VBM's ability to improve and solve current quality issues.

Although Mexico is seen to possess a highly skilled and efficient workforce, the identified need for developing systems and system interfaces will also positively influence quality. Upgrading the systems will arguably reduce manual procedures, decreasing the risk of human errors. A PN Factory upgrade would also require a better coordination between both internal departments as well as links to departments located at HQ and in other plants. This will further have positive affect on quality.

Nonetheless, having more individual suppliers could make the administrative issues in control and evaluation more demanding. This will of course require that sufficient resources are assigned to this so that a satisfactory level on the quality can be maintained. Quality will also be affected by the level of control and the standard of the operational process as a whole.

More specifically, we believe that becoming a PN Factory in Chassis will allow VBM to affect **quality** positively in the following ways:

- Will force VBM to look at almost all aspects of their operations, thereby helping to develop them further.
- Will allow a redevelopment and refining of process improvements to take place.
- Will allow VBM to reduce the waste and the risk of having missing parts in their production due to an increase in supplier control.
- Will allow VBM to increase their current competence as well as allow manoeuvrability to develop new capabilities.
- Will increase the communication level and allow a better alignment between internal departments as well as with "external" departments located at HQ in Sweden and at other plants.
- Will increase VBM's need for improved prognosis and scheduling capabilities which will further improve production activities.

- Will allow VBM to respond faster to market demands by having greater flexibility in production, hence improving customer perceived quality.
- Will allow VBM to have a much greater focus on suppliers they use and together with the right Supplier Evaluation Model have a positive affect on Quality.

6.2.3 Delivery

Delivery capability is a question of being able to deliver according to the customers' demands as well as ensuring that the supply of material is secured. Although the affects on delivery capability are believed will be positively influenced by becoming a PN Factory for Chassis in the long term, we would like to argue somewhat differently at the current time.

Operating as a PN factory means that more demand on timely delivery of material is needed. As part numbers will start arriving individually, the need for increased control and a more rigid process for receiving these will be required. Hence, it becomes important to consider if the current issues and concerns at VBM are of such magnitude that they can be solved by VBM. The delivery capability is likely to be negatively impacted by the lack of full access to a BOM for Chassis as well as no prior knowledge of dealing with the suppliers currently responsible for Chassis Part Numbers.

Hence, it is important to remember what the impact on this competitive priority would be before a comprehensive supplier evaluation is made. This would highlight for instance the supplier's ability to supply material to Mexico rather than to Sweden as this process might look somewhat different.

Overall, the impact of becoming a PN Factory for Chassis is likely to make the delivery process more complex and time consuming. VBM must remember that to manage the supply chain in an automobile company, it will be vital in order to handle changes in the fast evolving environment. In addition to this, it is our belief that the necessary systems to aid in this process are currently lacking. This can also be attributed to the fact that VBM has had no need to deal with European Chassis material suppliers. It has had to rely on VBB to take care of this, leading to a lack of knowledge and understanding of the characteristics of these suppliers.

Therefore, we believe that in order for the impact on the delivery capability to be positive in the short run, many outstanding issues need to be resolved. These are mainly related to the access to a full BOM, how to handle the DCN's for chassis and their meaning in terms of new suppliers, and also the issue of how to handle the shipment and logistics effects.

In the long run we are of the belief that by bypassing VBB there might be an opportunity to reduce lead times. This is simply because this will allow VBM to reduce the length of their supply chain thereby reducing lead times as well. If the lead time is reduced, so will the freeze time, ultimately leading to more flexibility for VBM. Also the recent trend within the automobile industry of moving towards JIT delivery systems, can help VBM reduce lead times.

Delivery capability is believed will be influenced in the following ways if VBM became a PN Factory for Chassis:

- Will be heavily affected by having the adequate scheduling and prognosis systems and procedures.
- Lead times will also be affected by the time it takes to find good suppliers able to deliver material needed for DCN implementations.
- Could be negatively affected by the increased customs process required to clear an increased number of Parts. This is furthermore dependant on the access to the necessary information required to clear goods at customs.
- Might suffer from increased workload due to the extensive number of additional part numbers that needs to be handled by the Traffic Department. This is reinforced by the fact that much of this work is currently undertaken manually.

6.2.4 Flexibility

The biggest effects that becoming a PN Factory will have on the competitive priorities is perhaps in relation to Flexibility. As stated earlier, flexibility refers to responding to and handling changes, more efficiently. This factor is essential when talking about an upgrade in the operations of a manufacturing plant. In the case of VBM, flexibility can be tied to many different issues areas described before.

As additional resources and extra costs are not always viable solutions for companies to consider, improving flexibility is seen as a perfect alternative to deal with change. By becoming a PN Factory for Chassis we believe that VBM will be in a better position to respond to external changes. This is believed to be so because by having full access and responsibility for a chassis, quicker decisions can be taken. This can furthermore have implications for changes that need to be made further down the production line, for instance, in body.

Also, by being able to make rapid changes to the material, and having greater flexibility in choosing suppliers, VBM can make quicker changes to their manufacturing process, if necessary. This is because having full information to the materials used and furthermore having decreased lead times and freeze times, it will become easier to implement any necessary changes. VBM will have the flexibility to source material from global, local, or even other Volvo units.

As VBM will have to start managing an increased number of suppliers it has already been mentioned that they will most probably have to overlook their prognosis and scheduling procedures. If they manage to ensure that this process is well developed and that schedules are accurate, this will indirectly affect the degree of flexibility within VBM. Being able to accurately know when and how much is needed of a specific part number and when this is required, will allow VBM to plan better thereby increase their flexibility.

Hypothetically, this would also allow VBM to have greater flexibility in terms of products. Nonetheless, due to the fact that the design of the chassis is believed to remain in Sweden, and because there currently is only a limited number of chassis variations available, this effect will not be that significant. The same could be argued for VBM's ability to increase their production volume or change it if necessary. Currently, they are dependent on one supplier (VBB) for the chassis. By having greater flexibility to choose their suppliers and the number of them they wish to have, a sudden increase in production volume should be easier to facilitate as there then will be more different suppliers to choose from. With NAFTA membership, competition in the domestic market has increased, making it crucial for VBM to adapt to this evolving environment. Flexibility can be seen as a key factor to achieve this.

The greatest impact on flexibility by becoming a PN Factory arguably is within VBM's ability to respond to the specific and so important customer needs and demands. And, when talking about demands, as stated earlier, there is an expected population growth particularly in developing countries. Hence, the demand for transport will also increase and VBM must be ready. This is also linked to the expanding middle and upper classes, the rise in consumer spending as well as the good demand for city Buses in Mexico due to long distances and lack of trains in the country. Although, the current number of chassis variations is limited, there is nothing saying that this will not change in the future. Being a PN factory will increase VBM's ability to respond to these demands.

In sum, it is our belief that **flexibility** will be impacted in the following ways:

- Having full access to the Chassis BOM will allow adaptation demands to fit the Chassis to the Body easier.
- The need to adapt and align systems better to each other, which includes a focus on creating more complete interfaces between the systems.
- The need for better communication and coordination between departments.
- Having better trust in the systems will furthermore allow more decision to be taken by systems automatically and reducing the need for time consuming manual work.
- Will allow VBM to track DCN changes better hence provide them with more time to plan for these changes.
- Will be increased with the potential implementation of the more integrated system SAP in the future.
- Provide VBM with an opportunity to re-evaluate the suppliers, and negotiate more flexible contracts when deemed necessary.
- Will in the longer term decrease lead times and the supply chain which will have a positive effect.
- Will make them have more control in making their own decisions.
- Requires an increase in DCN implementation knowledge.
- Requires more accurate scheduling and prognosis procedures.
- Will simply require VBM current processes and procedures to become more flexible.

6.2.5 Competence and Capability Development

As mentioned in the theoretical chapter of this thesis, it is important for a manufacturing plant to build up its competence and capabilities. In terms of the need and ability to develop new competencies and capabilities and in improving existing ones when upgrading to a PN Factory, we believe that the effect will be positive.

As the strategic upward migration to become a PN Factory arguably requires the development of new, or perhaps more important the development of existing competencies and capabilities, this will influence a companies ability to compete in the market. By this, a company will respond better to market demands at the same time as being able to provide products that are more competitive. This is not only in terms of cost and quality but also in terms of flexibility and delivery. All of this is essential to consider, taking into account that the Automobile sector is one of Mexico's most productive sectors.

The upgrading process to become a PN Factory further involves more reliance on the use of technology. This can be attributed to the increase in workload for the departments involved and in the complexity of the activities carried out. The increase of information flow and the need to be able to handle it correctly, implies that the use of technology will ensure that this process is as rigid and automated as possible, thereby reducing the risk of human errors. As stated previously, Mexico has access to world class technology; therefore it will not be difficult for VBM to find the correct systems for undertaking this upgrade.

It has further been identified that the change would require more focus on getting the processes and procedures right so that they are able to handle the different changes the upward migration implies. This will ultimately lead to the processes and procedures being modified to suit the new requirements, which automatically involves their improvement and constant evaluation. Additionally, the access and ownership of a complete BOM and bus specification, for chassis and body, will allow VBM's competence and capability in undertaking product design and modifications to increase. By having this access, it simply becomes easier for a company to have the fuller picture of the material needed in the production of a Bus. It is then believed that the requirements for becoming a PN Factory will lead to the need to

overlook all the current activities undertaken in order to identify where improvements need to be made. Following this, opportunities and the necessity for activity improvements will lead to an increase in competencies and capabilities. In addition to this, the change will furthermore “force” a company to identify the need for development of new competencies and capabilities.

As a result of the new and increased competencies and capabilities that PN Factory upgrade arguably requires, it will become easier for VBM to respond to changes in both its internal and external environment, thereby allowing it to respond correctly and timely to opportunities and threats that it might face in the future. It is our belief that the **competence and capability** competitive priority will be influenced in the following ways:

- Ability to handle costs and savings better.
- Ability to deal with quality issues and with more complex procedures.
- Increase the knowledge and ability to deal with Chassis Part Numbers.
- Develop the Chassis DCN implementation process and procedures.
- Better use and understanding of the systems currently used (GPS, KOLA, MFG/PRO).
- Improve ability to handle structural changes to the bus.
- Better coordination and teamwork between all departments.
- Process and procedure development skills.
- Develop their control mechanism and ability.
- Develop negotiation skills by having to deal with European suppliers and also the evaluation of these. Also contract negotiation skills.
- Increase their ability to deal with missing parts and material handling.
- Develop their supplier development skills by having to ensure that suppliers are giving the support they need and also increase their supplier knowledge in general.
- Increase their inventory control mechanism.
- Increase their competence in managing a more complex supply chain.
- Increase their competence and capabilities to respond to changes and market demands.
- Ability to create a more complete BOM, deal with it and also to maintain the accuracy of this.
- Increase competence and capability through general training needs identified.

6.2.6 Independability

As mentioned, the term Independability as used in this thesis relates to a manufacturing units connection to, or dependency of, another subsidiary in the corporate structure in terms of input material. Hence, it can imply a manufacturing plants ability to operate as a unit free from connections to another subsidiary. The strong connection to such a plant might influence its ability to develop new competence and capability and also influence its ability to have control over pricing and quality issues as well as decision making in terms of flexibility and delivery. It can be argued that by becoming a PN Factory, significant improvements on the strong reliance on another plant can be reduced.

One of the reasons for seeking to become a PN Factory is the desire to lessen dependability on another unit in the corporate structure and to take on a greater level of responsibility and control over the decision-making activities. By undertaking this change, VBM can reduce its total reliance on the ability of another unit for precious input material for which it cannot operate without. In a sense, we would like to argue that this is a sourcing issue, where too much reliance on one supplier of material will increase the risk of production line stops and also lessen the ability to respond to change.

Operating as a PN Factory allows for greater control and power to choose what the sourcing structure of production material should look like, hence lessening the reliance on one source. This also relates to the dependency due to the lack of vital information such as material specifications due to the division of responsibility and sourcing of material.

By operating as a PN Factory, more independent decision regarding assembly and construction procedures can be made, hence increasing flexibility and delivery priorities. This is because material can be selected and changed at more ease hence giving greater manoeuvrability for these. Furthermore, the increased knowledge, and understanding of product structures provides for this. Additionally, by having more responsibility and control over the length of the bus construction process, more independability can be obtained in the form of how the process should look like and process developments that can and should be undertaken.

It is our understanding that **independability** will be influenced positively in the following ways:

- More independent to negotiate their own prices for individual part numbers hence influencing the final price of chassis material.
- Better control over prices, costs and savings that can be set, incurred and made.
- Choice to evaluate and select suppliers according to their own needs.
- More responsibility to select the appropriate solution arising with chassis
- More manoeuvrability to directly with suppliers.
- Increase the level of information and hence reduce the dependability on this being accurately sent by someone else.
- More control over the whole supply chain.
- More control and independent to make decisions regarding the manufacturing process.
- By developing current and new human resource competencies and capabilities dependability can be reduced.

However, we believe that becoming a PN Factory for Chassis will decrease VBM's dependability on Sweden to a large extent but not totally. This is because the ownership of the BOM and maybe even the DCN changes will continue to be in the hands of the Engineering department in Sweden. This implies that as long as VBC continues to have centralised operations as global purchasing activities and global engineering activities, dependability can never be totally reduced. Further to this, there will always be operations that can be carried out better and more efficient by someone in the corporate structure and in those cases it would not make financial sense to strive towards total independence. In order to provide a better understanding and to easily identify the link and impact that the main issue areas had on the six competitive priorities; please refer to Appendix 11-14.

7 Conclusion

The conclusions in this thesis will aim to apply the theoretical framework illustrated in our conceptual model to the case study undertaken and thereby provide answers to the main problems and sub problems formulated. To provide a clear understanding of all the results of our research, we will use our developed “Investigation Model” from the problem formulation (Figure 3, p. 12). In other words, this figure will help us answer our main problem, by establishing what issues should be contemplated, why these issues arise, how they can be overcome, and how the upward migration will affect the competitiveness of the plant. All this will be done in terms of upgrading automobile manufacturing operations from a CKD Chassis Assembly Plant to a PN Factory. The figure below summarises the discussion that will follow.

Figure 10 Concluded Investigation Model

What does an Automotive Manufacturing Plant need to take into consideration when upgrading from a Completely Knocked Down Chassis Assembly Plant to a Part Number Factory?

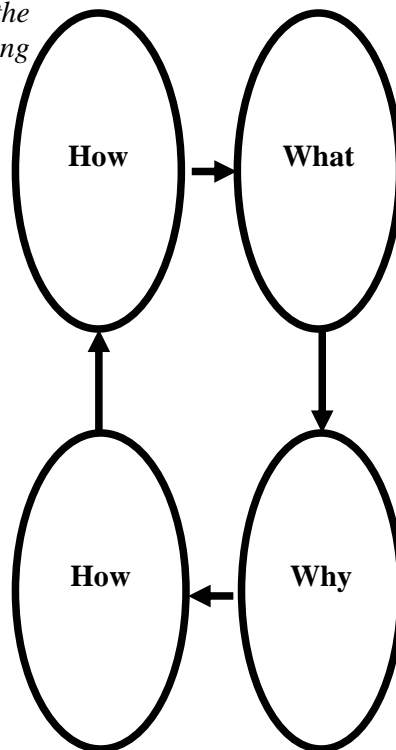
4. *How does the strategic upward migration of the Plant influence the competitive manufacturing priorities?*

- Cost Efficiency +/-
- Quality +/-
- Delivery +/-
- Flexibility +
- Competence & Capabilities +
- Independability +

3. *How can the manufacturing Plant overcome these operational issues?*

When enough understanding of the needs and requirements have been established.

Source: Authors' own elaboration



1. *What operational issues might arise when undertaking an upward migration from a CKD Chassis Assembly Plant to a PN Factory?*

- | | |
|--------------|----------------------------|
| 1. Cost | 6. DCN |
| 2. Systems | 7. HR needs |
| 3. Suppliers | 8. Local Integration |
| 4. Process | 9. Physical space |
| 5. BOM | 10. Scheduling & Prognosis |

2. *Why do these issues and concerns arise?*

- Understanding of cost & savings
- Needs for systems upgrade
- Increase in information flows
- Process development needs
- Need to improve supplier relationships
- Need to increase resources & Knowledge

The first circle illustrated as "What" will provide an answer to our first sub question:

"What operational issues might arise when undertaking an upward migration from a CKD Chassis Assembly Plant to a PN Factory?"

After accomplishing our study, we identified ten main issue areas that need to be taken into consideration in order to be successful in the implementation of a PN Factory. These issues have been detailed and analysed throughout the study and are: Cost, Systems, Suppliers, Process, BOM, DCN, HR needs, Local Integration, Physical Space and Scheduling and Prognosis. These issues and concerns seem to arise due to the limited experience, knowledge, and accessibility to the right procedures and information required to undertaking the strategic upward migration to become a PN Factory for Chassis.

These are moreover important issues that will have big impact on the possibilities of an automobile manufacturing plant to operate efficiently. Some of them are thus more crucial to address before undertaking any attempt to upgrade. It has been shown that, for instance, the necessity of having access to the appropriate systems and technology will have an affect on the possibility to deal with an increasingly complex Bill of Material which further will influence the ability to handle new DCNs'. These are further dependent on having the right processes and procedures in place, which furthermore can be a question of ensuring that employees have the adequate knowledge and skills.

The second circle identified as "Why", will answer our second sub question formulated at the beginning of this Thesis namely:

"Why do these issues and concerns arise?"

In this respect, and taking the case company VBM as an example, we can state that the operational issues identified arise because there is a need for a better understanding of, and a requirement for, investments regarding several key factors. More specifically we think that these are related to not having sufficient understanding of the cost and savings issues involved in the process, the need for upgraded and better systems and not satisfactory communication flow. Additionally, the accessibility to the correct and necessary information with regards to the BOM and DCN also gives rise to issues and concerns.

Moreover, it has been established that insufficient knowledge of the European suppliers' readiness level to supply directly to Mexico could be a cause for concern.

These issues are of major concern for VBM in its ambitions to upgrade its Chassis operations. In general we consider that some issues might require more time than others to be rectified, but in general terms we think that they all have a feasible solution. Hence, it could be said that they arise because of insufficient investments being made with regards to them.

Giving an answer to the third circle, identified as "How", we can respond to our third sub question:

"How can the manufacturing Plant overcome these operational issues?"

In order to respond to this question, it is necessary that an analysis of each issue area, and what is required to solve them is carefully undertaken. Already having established the reason for the occurrence of the operational issues, we suggest that a better understanding of how they can and will affect each other is required. Overall it must be remembered that the effect of these issues are tightly interlinked with each other and failure to successfully address them is likely to have implications throughout the manufacturing chain. It is our conclusion though that there are viable solutions to the issues mentioned. These will of course require investment and upgrading of several processes, procedures, systems, as well as the level of knowledge of the employees, but with the right support we don't believe this will be a major problem.

Providing an answer to the last sub question:

"How does the strategic upward migration of the Plant influence the competitive manufacturing priorities?"

we have managed to summarise our analysis on the case company VBM in the following table.

Table 4 Impact on VBM Competitive Priorities

Competitive Priority	Positive	Negative
Cost efficiency	X	X
Quality	X	X
Delivery	X	X
Flexibility	X	
Dependability	X	
Competence and Capability Development	X	

As can be appreciated in the table above, most impacts on the six competitive priorities are positive in relation to the upgrade of a manufacturing plant such as VBM to a PN Factory for Chassis. This in turn reinforces the fact that the idea for a manufacturing plant to upgrade to a PN Factory after reaching certain maturity in the market is a desirable change to undertake.

Nevertheless, some negative impacts can be expected in the beginning of the process before the correct procedures and processes have been learnt and established. Nonetheless, over time, as the processes and procedures are further defined and the right supporting systems put in place it should result in a positive influence on all the competitive priorities.

All the above leads us to an answer to the main problem of this thesis:

“What does an Automobile Manufacturing Plant need to take into consideration when upgrading from a Completely Knocked Down Chassis Assembly Plant to a Part Number Factory?”

If a manufacturing company is willing to upgrade its operations, it will need to answer the questions in the “Investigation Model”. These four questions need to be addressed and considered when a company wants to upgrade its operations from CKD Chassis Assembly Plant to a PN Factory. Of course, the upgrade will then depend on the amount of issues that must be solved and the time it takes the company to overcome them.

More specifically, what needs to be taken into consideration are the issues and concerns prevailing in the operational areas, which are most influenced by a potential strategic upgrade of an automobile manufacturing plant's activities. As it has been shown, these have different characteristics and also differ in importance.

Nonetheless, it is our understanding that there will always be problems and obstacles to undertake such a dramatic change and increase in manufacturing responsibility. What is important to remember though is that all problems have a solution if just enough effort is put into solving them. Hence, a plant can be ready when a satisfactory level of development and effort towards solving the prevailing issues has been made.

For VBM, this involves an effort toward ensuring that costs and savings are evaluated, that systems are adequate and information flow is increased. In addition they need to develop the processes, think on working on their supplier relationships, and on their resources and knowledge.

Last but not least, VBM can also think about local integration for the future. We conclude by stating that VBM is indeed capable of upgrading its operations to a PN Factory, however, it is a process that will take time and will require substantial investments and can furthermore not be done immediately. The ten issues that we have identified are crucial and VBM must now consider the possible solutions for them.

8 Recommendations

After establishing what is required for a company to consider when it decides to upgrade its operations from a CKD Chassis Assembly Plant to a PN Factory, and establishing the impact this could have on its competitive priorities, we continue by formulating recommendations for what could be done in order to facilitate the upward strategic migration. We believe that VBM should treat each issue according to the level of importance in this project. When establishing a work plan VBM will have to define what factors they should attack first. In brief terms and according to our understanding we would suggest the following:

First Consideration: To start with, we would like to recommend VBM to undertake a thorough cost and savings evaluation. Without this it cannot be known what the exact savings potentials are for becoming a PN Factory. This will not only help VBM to understand more in-depth where savings can be made but it will also make it easier to track the progress and evaluate the success of the implementation. By having established the cost saving potential, it will also become easier to justify why the migration of the plant is a positive process, and thereby also make it easier to sell the desire internally. This is of course important to bear in mind as there might be some resistance to the increase in manufacturing responsibility that this would stipulate, and also because of the impact it could have on other plants within VBC. Hence, establishing the exact cost breakdown of a CKD Kit is by us believed to be an important step towards becoming a PN Factory for Chassis.

By this, it will also become easier to evaluate what the future investment needs are likely to be, and how much additional financial resources can be freed and used somewhere else if deemed necessary. In particular we recommend VBM to evaluate whether this is the right time for them to become a PN Factory for Chassis based on the forecasted production volumes. It has to be remembered that reversing the change process once started could be a difficult task and incur additional costs.

Second Consideration: VBM will need to ensure that they have access to the adequate systems and technology required to operate efficiently as a PN Factory. For one, they will need to overlook the existing interfaces in order to ensure that the correct and necessary information can be obtained. By

improving the systems and the interface between KOLA, GPS and MFG/PRO, many quality issues could be solved, the usage of obsolete material could be avoided and the maintenance procedures become more efficient.

In addition to this, it needs to be investigated where manual procedures can be replaced by systems in order to reduce the risk of human errors and increase accuracy. In particular there needs to be a better understanding and use of the existent Volvo wide systems such as KOLA as this will help with the consistency in operations.

We also recommend VBM to thoroughly investigate what the implications of implementing the SAP system in the future will have for its operations. Perhaps it is so that the potential upward migration of the plant to a PN Factory for Chassis could be more easily facilitated when this system is in place. What needs to be avoided is to upgrade and develop current existing systems, only for them to be replaced within the next few years by SAP. This in our belief is not a viable solution as it would incur additionally unnecessary costs.

Alternatively, the MFG/PRO will need to be evaluated as the main tool to deal with the increased responsibility for Chassis Parts. VBM will have to evaluate whether it is more economically sound to upgrade this system now and use it in its operations or whether it will have to be replaced altogether.

We believe that the systems used should be improved or replaced before the upgrade takes place. This will facilitate the workload and provide more control in the day to day operations. We think that a good idea would be to implement the EDI system in the Logistics and Purchasing departments since manual work can be avoided, decreasing the possibility for human errors to occur.

We would also suggest that VBM consider the way they currently are doing their forecast and scheduling. As discussed, the importance of these could increase as VBM will have to deal with an increased number of suppliers who are dependent on this information to be as accurate as possible. The overall benefit of the above is an increase in technology know-how within VBM which could be a benefit no matter what the decision regarding the potential upgrade is. This will have a positive impact in the capability development of VBM and could facilitate its ability to operate even more efficiently and effectively in the future.

Third Consideration: We also would like to recommend VBC to provide VBM with the necessary information regarding specifications of the BOM. By having more and better access to the full BOM for Chassis, all adjustments to the production process can be made quicker and the DCN changes can be implemented faster.

Furthermore, since the Logistics department is seen as the most critical operational area in this project and most of the competitive priorities are tightly connected to this division, the more effective their work, the fewer problems they will have related to the delivery and missing parts. If the company makes correct Call Offs of the material that will be used in the production line, unnecessary procedures and transactions can be avoided. This in turn will have a direct impact on unneeded working hours, payments and time.

The possibility to have a complete BOM for Chassis is dependant on having the right systems and the right accessibility to its information. No matter what the decision regarding the potential upgrade is, we believe that this is an important issue to take into consideration as it will arguably facilitate the work between Chassis and Body and also increase the general knowledge, understanding, and expertise of employees at VBM. This will also decrease the feeling of operating with a “black box”. Hence, VBM needs to investigate more specifically what these information requirements are and establish how they can be provided. This involves looking closer at the interfaces between the necessary systems and ensuring that this information can be accurately transferred and obtained. As argued this is a business decision that needs to be taken as soon as possible.

Providing this information would have positive effects on reducing VBM’s dependability on other departments and plants in their operations. It would also allow VBM to ensure that their manufacturing processes are operating in a way that best suits the needs of both the chassis and the body of the bus and that these are in line.

Fourth Consideration: We consider that the process to upgrade VBM to a PN Factory for Chassis could happen but that it will still take some time. First VBM must finish accomplishing the upgrade of its operations for its body parts. When VBM has managed to fulfil their goal of becoming a PN Factory for body, only then will VBM be ready to think of the CKD Chassis Assembly Plant upgrade. However, it needs to be ensured that the processes for body are

adequate to handle chassis as well as a duplication of activities needs to be avoided. This could lead to unnecessary costs and workload and does not facilitate administrative economies of scale.

We also think that it is essential that VBM does not start a new project without finishing the body processes and making sure that they are rigidly in place. If this is not ensured, additional problems could arise. If they wait until all their body parts are included as part numbers, then VBM can actually obtain more benefits from that. By waiting to do one thing at a time will help them compare the situation and solve any difficult circumstances that happened previously. They can learn from past errors and avoid falling into the same mistakes.

Mapping the process clearly from the start and including the participation of all ten operational departments from the beginning, will allow VBM to avoid making mistakes during the upgrade process. It is essential for VBM to get it right the first time as we do not think that there is room for processes that are not accurate or in need of further development. The complexity of operations and the potential cost implications this would have is to be avoided at all times.

Additionally, we consider that in order for the company to accomplish the upgrade from a CKD Chassis Assembly Plant to a PN Factory, it is crucial that VBM improves the communication flow between all the ten operational areas involved in the process. The need to co-ordinate with all internal and external areas is crucial for the process to run smoother. The operational areas should understand that they are working for the same goal, hence require support from each other and mutual respect. We think that by providing the correct assistance before the implementation takes place, could avoid future problems.

In addition to this, when the upgrade process takes place, we would like to recommend VBM to upgrade the part numbers according to certain basic standards and classification. One idea could be to upgrade the part numbers with a PROSEC status first and then continue with the ones with a beneficial FTA, always starting with the ones that have to pay less tax. In that way VBM would integrate the part numbers with a beneficial status first, leaving the complicated ones for the end when VBM has more experience and can deal with the new situation in a more efficient manner. Establishing a product classification, can provide VBM with a higher level of control.

What also needs to be considered is how to increase the level of control of material and processes. With the potential complexity and increase in workload which operating as a Chassis PN Factory arguably entails, it is pivotal that the adequate control mechanisms are in place. This includes systems control as well as procedural controls, and finally, inventory controls.

It has also become evident that the experience of dealing with Chassis DCNs' is quite limited at the moment. We, therefore, recommend that provision to learn from the way these DCNs' are implemented by VBB is made. This could, for instance, involve closer communication or even undertaking visits to VBB by the Beredning department at VBM so that they can better understand how to deal with this change. This would arguably also increase their general knowledge of dealing with DCNs'.

Fifth Consideration: What also is recommended is to undertake an evaluation of the Chassis Part Number suppliers to identify their possibilities and ability to supply the material to Mexico. As discussed in the empirical section, the proposed import of individual part numbers from Europe will also require the suppliers to have the knowledge to deal with the more complex procedures of exporting to a non-European country. What might be needed is to make provision for the education and development of the suppliers' ability to handle the new regulatory requirements.

One way to evaluate this ability is perhaps to develop the Supplier Evaluation Model currently used or to increase its current use altogether. This will allow VBM, at an early stage, to start tracking the suppliers' ability to deal with the change in delivery which exporting to Mexico arguably implies.

It must also be remembered that in order to facilitate the importation of material from Europe, VBM will be required to have additional information regarding the specific part number in question. As mentioned earlier this constitutes knowing:

- What the part number is
- The technical description of that part number
- What technical support the part number requires

All together, VBM needs to ensure that the suppliers are aware, ready, and able to deliver the required material to Mexico in an efficient manner so that production line stops and the risk of missing material can be reduced. Moreover we recommend that VBM acquires good communication and co-ordination with their customs brokers in order to establish the new conditions with them when becoming a PN Factory.

Sixth Consideration: We think that not only the company perspective or ambitions should be looked upon, but the individual capability and motivation must also be taken care of. The better the capability imbedded in the employees, the higher VBM's ability to achieve better results will be. If the employees are happy in the organisation and feel that they can give their opinion regarding any subject, it can reinforce their ambitions and improve the work motivation in the company. It is very important for a company especially if it will change its procedures, to think on the organisational climate and how it can overcome obstacles or differences between the operational areas involved.

In particular we would recommend VBM to look deeper into the specific training needs that exist within the company. It is our understanding that as many people within VBM are new, there is a lack of experience currently existing in some areas, especially at the levels below management. Therefore, we believe that adequate training possibilities could compensate for this. In combination with the identified need for new or developed systems, this could reduce the need for additional human resource which also has to be taken into consideration.

Thus, the provision for physical storing space has to be highlighted. As the chassis material is so important for the construction of the bus, receiving it in several batches at different times could affect VBM's possibilities to control the storage and movement of the material. What is needed is to ensure that enough storage space, preferably closed storage space, is available at VBM once the level of Chassis Part Numbers reaches a large volume. This also includes ensuring that satisfactory control mechanism are put in place for this material in terms of quality, wastage, general storage, and the movement of material.

Seventh Consideration: To conclude, we think that VBM needs to start considering and investigating the potential and possibility to start buying local part numbers already at this stage. We do not propose that they should start buying from local suppliers in great quantities as we earlier stated that we think that the Chassis PN Factory processes and procedures first must be implemented and understood. However, if VBM starts investigating what part numbers might be bought locally at an early stage, the contact and development of the suppliers should be made early on, ensuring that the suppliers are also aware of this desire. Nonetheless, we stipulate for VBM to think about local integration with suppliers once the migration to become a Chassis PN Factory has been evaluated and completed with the European ones.

9 Further Research Area

In light of the research we have undertaken several interesting areas have been touched upon but which were deemed to lie outside the scope and purpose of this study. This would be interesting to investigate in future research projects as they will not only provide a better understanding of manufacturing strategies but could also provide further light and validity to similar projects undertaken such as ours.

It would be interesting to undertake a more in-depth investigation of the typologies used by Dicken to provide a more detailed description of the automobile industry development stages. This is because it has been understood through this thesis that there are several stages than the four proposed by Dicken that the automobile industry could pass through. More specifically, it would be interesting to find validation for and find out if an industry actually could pass through more development stages such as:

- CBU – Assembly of Completely Built Up Parts
- SKD – Semi Knocked Down Parts which can be described as a combination of Knocked Down and Partly Knocked Down (different part numbers already assembled) items.
- CKD – Assembly of Completely Knocked Down Parts
- CK/PN Factory - Assembly of Knocked Down and Part Numbers from non-local suppliers.
- PN Factory with non-local suppliers – Assembly of Part Numbers from non-local suppliers.
- CK/PN Factory - Assembly of Knocked Down Parts and Part Numbers with increasing local content.
- PN Factory with foreign parts – Assembly of Part Numbers from non-local suppliers.
- PN Factory Local Integration - Assembly of Part Numbers from local suppliers.

Additionally, the model proposed by Ferdow regarding the strategic role of foreign manufacturing plants could perhaps also be further developed. Through his research it became evident that foreign manufacturing plants evolve over time to take on a greater strategic role and responsibility.

He argues that plants can develop from being mere low cost, low skills plants to plants that other plants depend upon. However, it has become evident that manufacturing plants could be considered as low cost, low skill plants but still be crucial for the production activities of other plants. Hence, it is interesting to investigate further in detail the exact role that these plants can play for a TNC and its operations.

10 Reference List

Books

Andrew, M., 1999. Automotive sectors of Latin America. Prospects to 2004. Research Report. The Economist Intelligence Unit Limited, London

Bartlett, C.A., Ghoshal, S. 1998. Managing Across Borders: The transnational solution. Random House Business Books, London

Chase. R.B, Quilano, N.K 1991. Production and Operations management – A life cycle approach, , sixth edition, Richard D. Irwin Inc., ISBN: 0-256-12811

Chisnall P.M., 1997. Marketing Research, fifth edition. McGraw – Hill

Dicken, P., 2003. Global Shift, Transforming the World Economy, fourth edition. SAGE Publications Ltd., Great Britain, Cromwell Press, Trowbridge, Wiltshire. ISBN: 0-7619-7149-1

Hill Charles W.L, 2001. International Business, competing in the global marketplace: Postscript 2001, third edition. McGraw-Hill Higher Education, ISBN: 0-07-239196-0

Jack, D., 2000. The Global Bus and Coach Industry. Trends and outlook to 2005. Research Report. The Economist Intelligence Unit, London.

Jack, D. Gibbins, E., 2002. The World Bus & Coach Manufacturing Industry. A “Truck & Bus Builder” market Report. Second edition. Truck & Bus Builder Reports, Ltd. England

Johnson G. and Scholes K, 1999, Exploring Corporate Strategy – text and cases, fifth Edition, Perason Education ltd. Prentice Hall Europe, ISBN: 0-13-080740-0

Kinncar, T and Taylor, J., 1991. Marketing research, an applied approach. McGraw-Hill, Cop.

Mattsson, S.A. 2000. Embracing Change, Management Strategies in the e-economy era. Graphium/Västra Aros, Intentia Publishing, Sweden.

Nilsson, C.H., 1995. On strategy and manufacturing flexibility, Department of industrial engineering , Lund Institute of Technology, Lund Sweden, ISBN91-628-1500-8

Poillon, C., 2000. Getting started in Emerging Markets, comprehensive coverage. John Wiley & Sons, Inc., New York

United Nations, 2000. The Competitive Challenge: Transnational corporations and Industrial restructuring in developing countries, New York.

United Nations, 2001. World Investment Report. Promoting Linkages, New York

Wild, J.J., Wild K.L. and Han J.C.Y., 2003. International Business, second edition. Prentice Hall

Yin, R. K, 1994. Case Study Research: Design and Methods, second edition. Thousands Oaks, CA: Sage corp.

Articles, Magazines & Reports

Alvstam C.G., Ivarsson, I., 2003. Technology Transfer from TNCs to Local Suppliers in Developing Countries: A Study of AB Volvo's Truck and Bus Plants in Brazil, Mexico, China and India. Paper submitted to World Development, 2003-09-03

Brizzi, A., Ahmed, K. & Kojima, M., Dixon, J.A., Hamilton, K. Mexico: A Comprehensive Development Agenda for the New Era. A Sustainable Future, Chapter 4, pp. 117-132

Buss branschen, 2002

(1) Volvo Bussar framgångsrikt i Mexiko, Vol. 8, No. 7, pp. 34-35

(2) Volvo Bus de Mexico: Här finns marknaden, Vol. 8, No. 9, pp. 29-33

Coates, T.T, McDermott, C.M, 2002. An exploratory analysis of new competencies: a resource based perspective, *Journal of Operations Management*, Volume 20, Issue 5, September, pp. 435-450

Corbett L.M and Claridge, G.S 2002. Key manufacturing capability elements and business performance *International Journal of Production research*, ISSN 0020-7543, Vol.40, No.1, pp-109-131.

Duray, R. and Ward, P.T, 2000. Manufacturing Strategy in context: Environment, Competitive Strategy and Manufacturing Strategy, *Journal of Operations Management*.

Fleury, A, 1999. The changing pattern of operations management in developing countries: the case of Brazil. University of Sao Paulo, Brazil, *International Journal of Operations and Production Management*, Vol. 19, No. 5/6, pp. 552-564.

Gagnon, S., 1999. Resource-based competition and the new operations strategy. *International Journal of operations and Production Management*, Vol 19, No. 2, pp.125-138.

GPN Working Paper 7, May 2003, Global production networks in Europe and East Asia: the automobile components industry. Part of the ESRC Research Project R000238535: Making the connections: Global Production Networks in Europe and East Asia.

International Energy Agency (IEA). Priddle, R., Executive Director. *Bus Systems For The Future, Achieving Sustainable Transport Worldwide*.

Khanna V.K., Vrat P., Shankar R., Sahay B.S., Gautam A., 2003. TQM modelling of the automobile manufacturing sector: a system dynamics approach. *Journal of Work Study*, Emerald, Vol. 52, Issue 2, pp. 94-101

Ling X. Li, L, 2000. Manufacturing capability development in a changing business environment. Southern Illinois university, *Industrial management and Data Systems*, 100/6, pp.261-270

Maletic, T. Ristov, T., 1998. År2000 - problemets påverkan på verksamheten – en teoretisk studie av År2000-problemets konsekvenser på informations samlning, kommunikation och beslutsfattande. Kandidatuppsatts i Informatik vid institutionen för data och affärsvetenskap 1999:K31

Milgate, M., 2001. Supply chain complexity and delivery performance: an international exploratory, *Supply Chain Management* 6-106

Phene, A, and Almeida, P, 2003. How do firms evolve? The pattern of technological evolution of semiconductor subsidiaries, *International Business Review*, Vol. 12 June, Issue 3, pp. 349-267

Pyke, D, 2000. A framework for operations strategy. The Amos Tuck School - Dartmouth College. Published as: The way forward for operations strategy, *Financial Times*, Part four of *Mastering Management*, October 23rd.

Rodriguez Perez, J., Ordoñez de Pablos, P., 2003. Knowledge management and organisational competitiveness: a framework for human capital analysis. *Journal of Knowledge Management*, Vol. 7, No. 3, pp. 82-91, MCB UP Limited.

Rudberg M., 1999. *Manufacturing Strategy: Linking competitive priorities, decision categories, and manufacturing networks*, Linköping Universitet, Dissertations from the international graduate school of management and industrial Engineering

Santamaria, S., 2001. *A strategic study of assembly plant establishment in the Kingdom of Saudi Arabia*, Linköping University Electronic Press

Schroeder, R.G., Bates, K.A., Junttila, M.A. *A Capability-Based View of Manufacturing Strategy and the Relationship to Manufacturing Performance*. Carlson School of Management, Minneapolis; University of Toronto, Canada; Helsinki University of Technology, Finland.

Seminar 16th May, 2003, Roger Schweizer

Shi, Y, and Gregory, M, 1998. International manufacturing networks – to develop global competitive capabilities. *Journal of Operations Management*, Vol. 16, 1998, pp.195-214

Shimokawa, K. Reorganisation of the Global Automobile Industry and Structural Change of the Automobile Component Industry, TokaiGakuen University.

Tellis W., 1997. Application of a Case Study Methodology. *The Qualitative Report*, Volume 3, Number 3.

Tranfield, D., Smith, S. 1998. The strategic regeneration of manufacturing by changing routines, *International Journal of Operations & production Management*, Vol 18, No 2, pp.114-129, MBC University Press

Vereecke, A., Van Dierdonck, R., 2002. The strategic role of the plant: testing Ferdows's model. *International Journal of Operations & Production Management*, Vol. 22 No.5, pp.492-514. Vlerick Leuven Gent Management School and Ghent University, Ghent, Belgium.

Volvo Bus News, 2003. Volvo Buses at Busworld, October, p.11

Voss C.A, 1995. Alternative paradigms for manufacturing strategy, *International Journal of Operations and Production Management*, Vol.15, No.4, pp.5-16

WARD'S Autoworld, 2001. Volvo Library Mexico goes on Siesta, Brian Corbett, December p. 43. www.wardsauto.com

Weimark M., 2000. In search of strategic consistency- a model of evaluation of how strategies support objectives, Department of industrial dynamics, School of technology Management and Economics, Chalmers University of technology, Sweden.

Websites

www.Allrefer.com

Mexico, Industry, Manufacturing - Data as of June 1996

<http://www.lupinfo.com/country-guide-study/mexico/mexico70.html>

Bancomex, 2003.

Invest in Mexico, Ministry of the Economy. The Automobile sector in Mexico: A global player and strategic partner for investment.

<http://www.economia-bruselas.gob.mx/english/publications/fs02-automobile.htm>

www.busride.com

Busride Magazine, 2003. Volvo Bus de Mexico, June 17, 2003

www.emerald-library.com

www.Sixsigma.com

Padhi, N., 2003. The Eight Elements of TQM

<http://www.isixsigma.com/library/content/c021230a.asp>

www.volvo.com

www.volvotrucks.volvo.com

volvotrucks.volvo.com/pages/0,2073,628,00.html?market=ME&MID=446

World Market Research Centre, 2003

WMRC Country Report: Mexico, September - 2003

Company Material

Volvo Bus Borås: Company Presentation, Leaflets on Volvo Buses,

Volvo Bus de México: Company Presentation, VBM intranet, Documents from VBM's operational areas

Interviewees

Alberto Febronio, Warehouse, Inventory Control, 24 October/03

Arturo Alanís, Traffic Head of Traffic, 21 October/03

Claes-Göran Persson, VBB, Manager CKD-Operations & Projects. 13 October/03

Reference List

Emilio Torres, Warehouse Head of Warehouse, 24 October/03

Enrique Rustrián, IT, Chief Information Officer, 28 October/03

Fernando Bastida, Finance, Controller, 28 October/03

Hector Nuñez, Process Engineering, Head of Industrial Engineering and Process, 27 October/03

Ignacio Aguirre, Beredning Head of Beredning, 21 October/03

Javier Montes, Spare Parts, Purchaser, 22 October/03

José Martínez, Production, Production Director, 29 October/03

Kent Olsson Material, Head of Materials, 20 October/03

Kjell-Arne Lindvall, Product Development, Head of Product Development 29 October/03

Mario Moreno, SQA, Supplier Quality Assurance, 22 October/03

Mats Lindevall, Purchasing, Global Buyer, 30 October/03

Mauricio Meugniot, Logistics, Head of CKD's, 30 October/03

Mirsad Sela, VBB, Project Manager CKD-Operations, 13 October/03

Nicolas García, Purchasing Purchaser, 22 October/03

Pedro Espinosa, Logistics Head of Logistics, 23 October/03

Rafael Kisel, Purchasing Purchasing Director, 22 October/03

Ramón González, Process Engineering, Industrial Engineering Co-ordinator 27 October/03

Roberto Almaguer, Purchasing Global Buyer, 22 October/03

Rodolfo Fuentes, Warehouse, Warehouse Supervisor, 24 October/03

Thomas Fransson, Global ICT Chief Information Officer Volvo Buses 16 October/03

Tomas Håkansson, Consultant, 3 November/03

11 Appendix

Appendix 11-1 Production by country & vehicle type 1998 - 2004

Volvo: production by country and vehicle type 1998 -2004 * (units)							
	1998	1999	2000	2001	2002	2003	2004
Brazil							
HCV	6,380	4,200	4,800	5,900	6,380	7,100	7,800
Mexico							
HCV	488	500	550	580	600	620	700
TOTAL	6,868	4,700	5,350	6,480	6,980	7,720	8,500

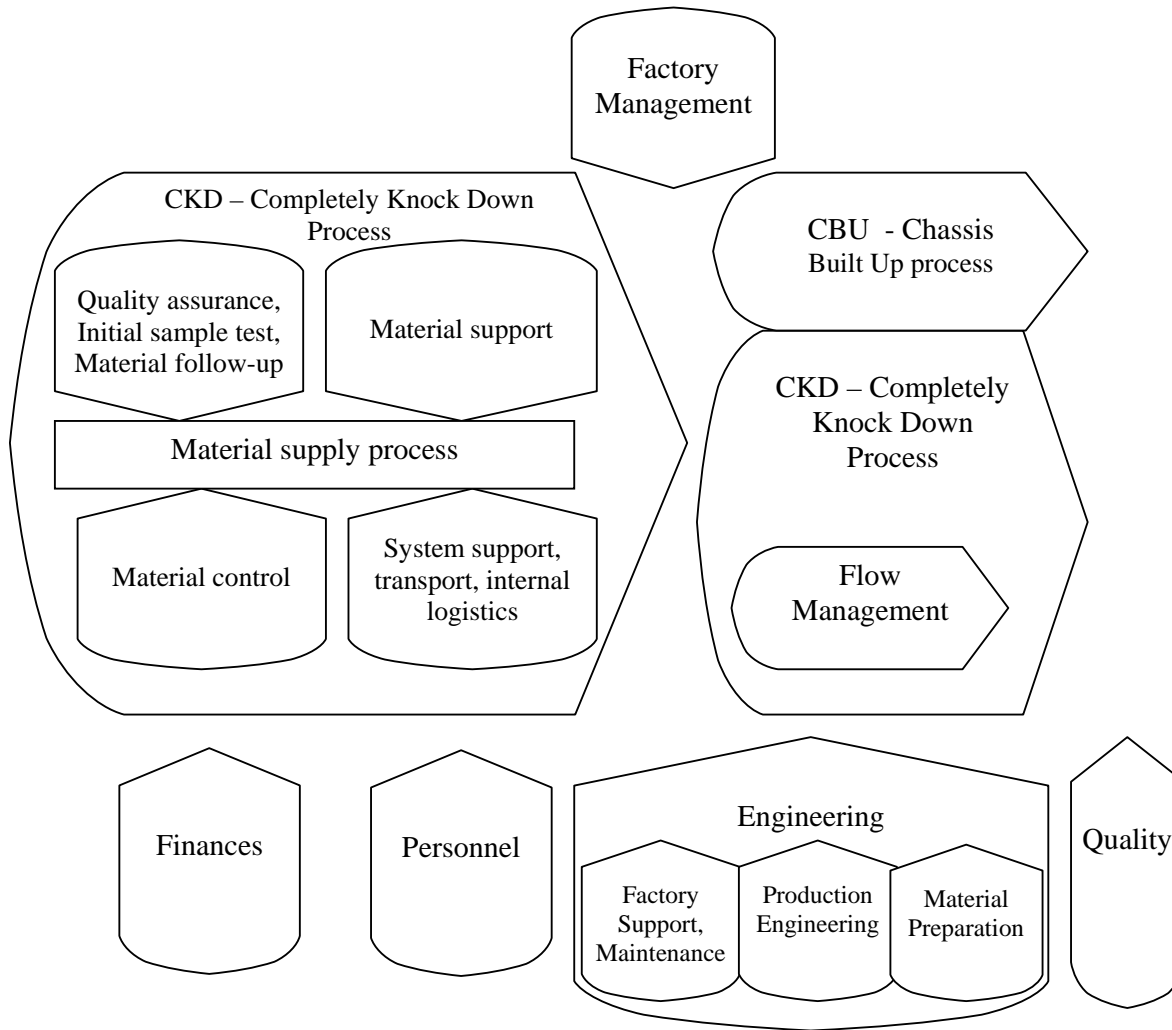
* Figures for 1998 are actual, the remainder are forecasts. Source: Andrew, 1999

Appendix 11-2 Sales by country & vehicle type 1998 - 2004

Volvo: sales by country and vehicle type 1998 -2004 * (units)							
	1998	1999	2000	2001	2002	2003	2004
Brazil							
HCV	5,169	3,220	3,800	4,638	5,130	5,798	6,450
Mexico							
HCV	614	500	580	736	876	910	1,035
TOTAL	5,783	3,720	4,380	5,374	6,006	6,708	7,485

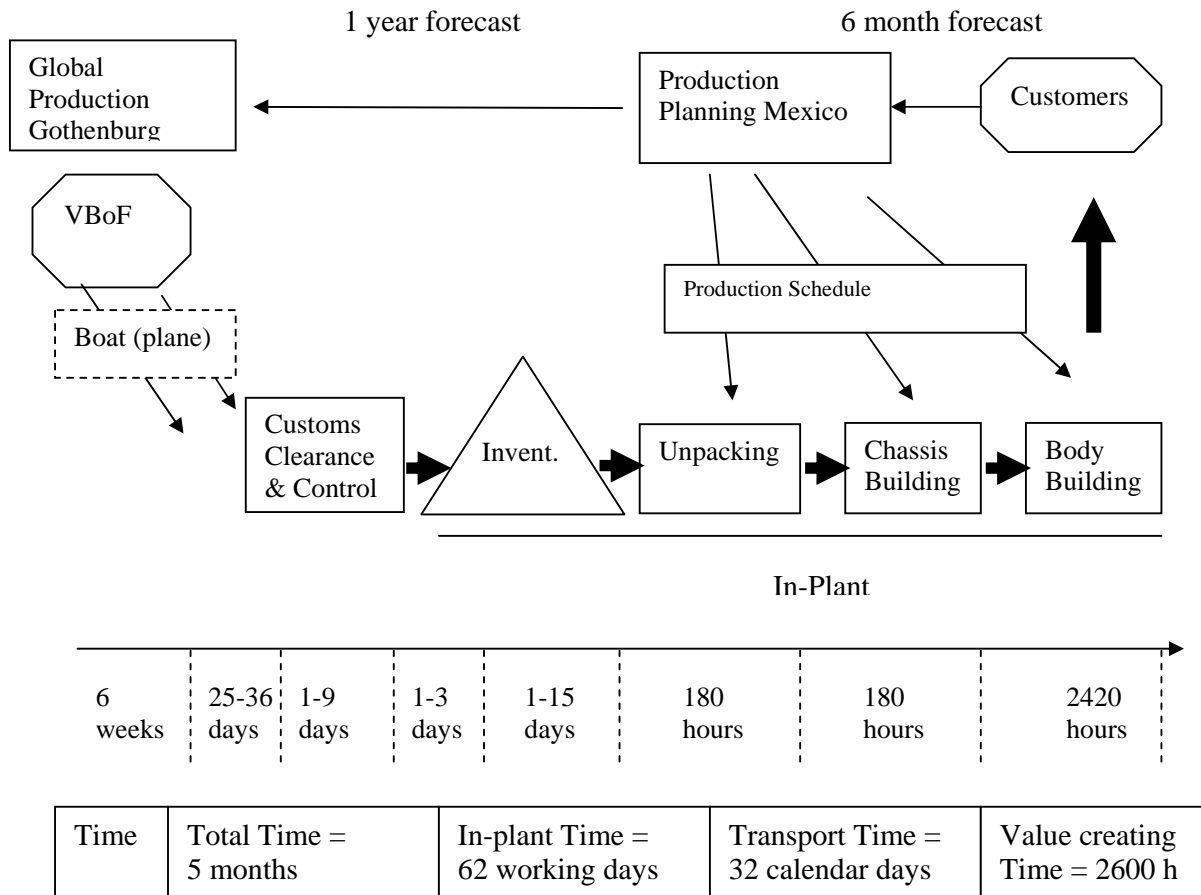
* Figures for 1998 are actual, the remainder are forecasts. Source: Andrew, 1999

Appendix 11-3 VBB Current Structure



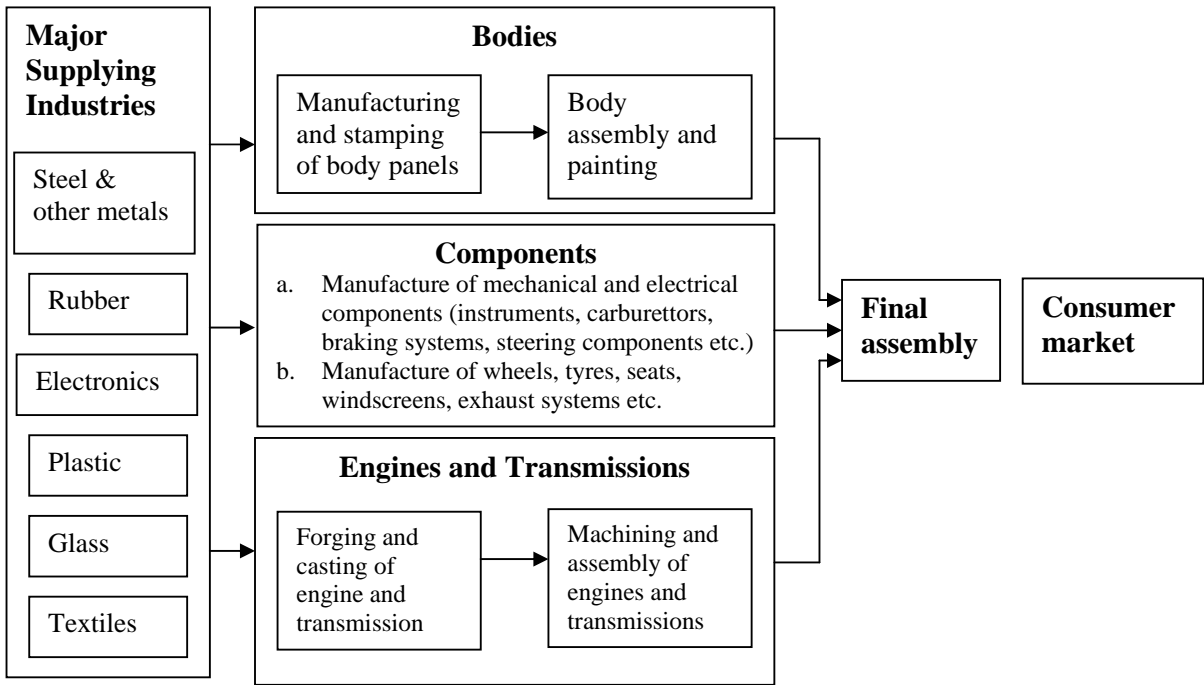
Source: Adapted from Volvo Bus Borås, 2003

Appendix 11-4 VBM Current State Map



Source: Adapted from Volvo Bus Borås, 2003

Appendix 11-5 The Basic Automobile Production Chain



Adopted from: GPN Working paper 7, 2003

Appendix 11-6 Interview Participants

SWEDEN			
NAME	DEPARTMENT	POSITION	DATE
Claes-Göran Persson	Volvo Bus Borås	Manager CKD-Operations & Projects	13 October/03
Mirsad Sela	Volvo Bus Borås	Project Manager CKD-Operations	13 October/03
Thomas Fransson	Global ICT	Chief Information Officer Volvo Buses	16 October/03

MEXICO			
NAME	DEPARTMENT	POSITION	DATE
Kent Olsson	Material	Head of Materials	20 October/03
Arturo Alanís	Traffic	Head of Traffic	21 October/03
Ignacio Aguirre	Beredning	Head of Beredning	21 October/03
Rafael Kisel	Purchasing	Purchasing Director	22 October/03
Roberto Almaguer	Purchasing	Global Buyer	22 October/03
Nicolas García	Purchasing	Purchaser	22 October/03
Mario Moreno	Supplier Quality Assurance	Supplier Quality Assurance	22 October/03
Javier Montes	Spare Parts	Purchaser	22 October/03
Pedro Espinosa	Logistics	Head of Logistics	23 October/03
Emilio Torres	Warehouse	Head of Warehouse	24 October/03
Alberto Febronio	Warehouse	Inventory Control	24 October/03
Rodolfo Fuentes	Warehouse	Warehouse Supervisor	24 October/03
Hector Nuñez	Process Engineering	Head of Industrial Engineering and Process	27 October/03
Ramón González	Process Engineering	Industrial Engineering Co-ordinator	27 October/03
Enrique Rustríán	IT	Chief Information Officer	28 October/03
Fernando Bastida	Finance	Controller	28 October/03
José Martínez	Production	Production Director	29 October/03
Kjell-Arne Lindvall	Product Development	Head of Product Development	29 October/03
Mauricio Meugniot	Logistics	Head of CKD's	30 October/03
Mats Lindevall	Purchasing	Global Buyer	30 October/03
Tomas Håkansson		Consultant	3 November/03

Appendix 11-7 Dicken - Development Sequence

Stage 1: Import of completely built-up (CBU) vehicles by local distributors: This tends to be limited in scale because of high transport costs and possibly by government import restrictions.²²⁹ CBU's are completed chassis or Body structures that are assembled in one country and the exported to another for further value adding activities.

Stage 2: Assembly of completely knocked-down (CKD) vehicles: Vehicles are imported from the home plants of world manufacturers. This permits transport savings and provides the opportunity to make minor modifications for local market.²³⁰ CKD's are complete parts for a chassis or Body structure broken down into its basic parts, or Part Numbers, and the packed for export to another country for assembly.

Stage 3: Assembly of CKD vehicles but with increasingly local content: This both depends upon, and encourages, the development of local components industry. It is strongly favoured by local governments.²³¹ This involves the reduction of the Part Numbers imported in a CKD Kit and the increasing purchase of Part Numbers from local suppliers.

Stage 4: Full-scale manufacture of automobiles: This tends to be restricted to a smaller number of countries than stages 2 and 3. It is by no means inevitable that countries, which have reached stage 3, will then move to full-scale local manufacture. It is even possible that a country might regress from the status of full-scale local manufacturer to that of mere assembler.²³²

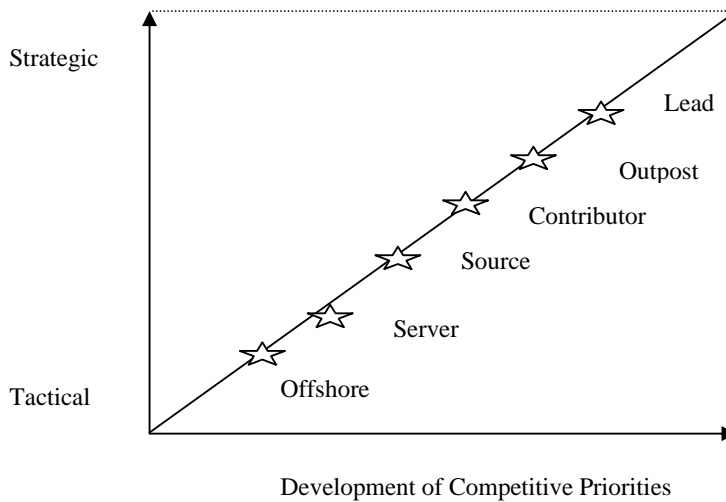
²²⁹ Dicken, 2003

²³⁰ ibid

²³¹ ibid

²³² ibid

Appendix 11-8 Ferdow – The role of plants and strategic contents



Adopted from: Considerations about robust networks and evolution of Brazilian automobile industry (adaptation)

Offshore Factories are primarily established to gain advantage over lower wages or production costs. Plants are low-cost oriented and no innovative goals are usually established for them. The work undertaken at such plants is furthermore routine based and centrally planned, with low investments in technical and managerial resources.²³³

Source Factories are upgraded versions of an Offshore Factory and also established with low production costs in mind. However, these factories usually possess a specific competence that allows them to develop and/or produce a product that can be of global use for the organisation.²³⁴

Server Factories on the other hand, are specifically established to serve local consumers. Their primary reason for existence is to overcome tariff barriers, as well as to reduce taxes, assembly costs and foreign exchange-fluctuations. Server factories can be given additional tasks that Offshore factories do not have, including the responsibility to undertake minor product modifications in order to fit local demands. Nonetheless, the competence in such factories is generally believed to be low.²³⁵

²³³ Santamaria, 2001

²³⁴ ibid

²³⁵ ibid

Contributor Factories are upgraded Server Factories and also serve local markets. However, in addition to this, these factories are also responsible for product customisation, process improvements or even product development.²³⁶ The decision to establish an *Outpost Factory* is believed to be in order to gain access to or collect specific knowledge or skills. This might be with regards advanced suppliers, competitors, customers, or research laboratories. These factories have additional roles similar to server, or offshore factories.²³⁷

Lead Factories are established in order to gain access to a competence that can innovate and create new products or processes for a firm. The Lead - plant contributes to the company's strategy by developing manufacturing capabilities and sharing these capabilities with other plants in the manufacturing network of a TNC.²³⁸

²³⁶ Santamaria, 2001

²³⁷ ibid

²³⁸ ibid

Appendix

Appendix 11-9 Production in Mexico & vehicle type 1998 - 2004

	1998	1999	2000	2001	2002	2003	2004
Passenger cars	952.9	990.8	1,104.9	1,203.5	1,211.3	1,244.0	1,264.8
Light commercial vehicles	465.4	432.3	527.8	673.5	707.3	697.0	686.9
Heavy commercial vehicles	37.5	40.9	43.7	45.6	47.5	49.3	51.9
TOTAL	1,455.9	1,464.0	1,676.4	1,922.6	1,966.1	1,990.3	2,003.6

Source: adapted from EIU forecasts, Andrew, 1999

Appendix 11-10 World: Actual & forecast Bus & Coach sales to 2005

	1997	1998	1999	2000	2001	2002	2003	2004	2005
Western Europe	20,687	24,317	24,160	24,155	23,670	23,455	23,690	23,810	24,005
Eastern Europe	19,664	18,835	19,300	19,530	20,980	22,540	23,565	25,280	26,790
NAFTA	55,213	57,326	58,840	59,400	59,600	60,150	60,450	58,750	59,050
South America	20,440	22,866	16,455	19,135	21,430	22,950	24,520	25,530	25,950
Asia & Australasia	72,968	64,721	60,855	62,905	68,000	70,615	75,965	78,890	81,840
Africa & Middle East	3,240	3,420	3,480	3,530	3,830	4,370	4,680	4,890	4,890
TOTAL	192,212	191,485	183,090	188,655	197,510	204,082	212,870	217,150	222,525

* figures from 1997-1998 are actual; the remainder are forecasts, Source: Jack, 2000

Appendix 11-11 Mexico: Production of Buses & Coaches 1995 - 2001

Mexico: Production of Buses and Coaches 1995-2001							
Over 8.0 tonnes gross							
	1995	1996	1997	1998	1999	2000	2001
Diesel Nacional	152	317	503	511	479	438	483
MASA/Volvo	86	248	477	959	749	644	783
Mercedes-Benz	0	0	0	0	0	0	888
Omnibuses integrals	77	71	0	0	0	0	0
Scania	0	0	0	0	20	196	381
Others	0	0	0	0	0	217	175
TOTAL	315	636	980	1470	1248	1278	2710

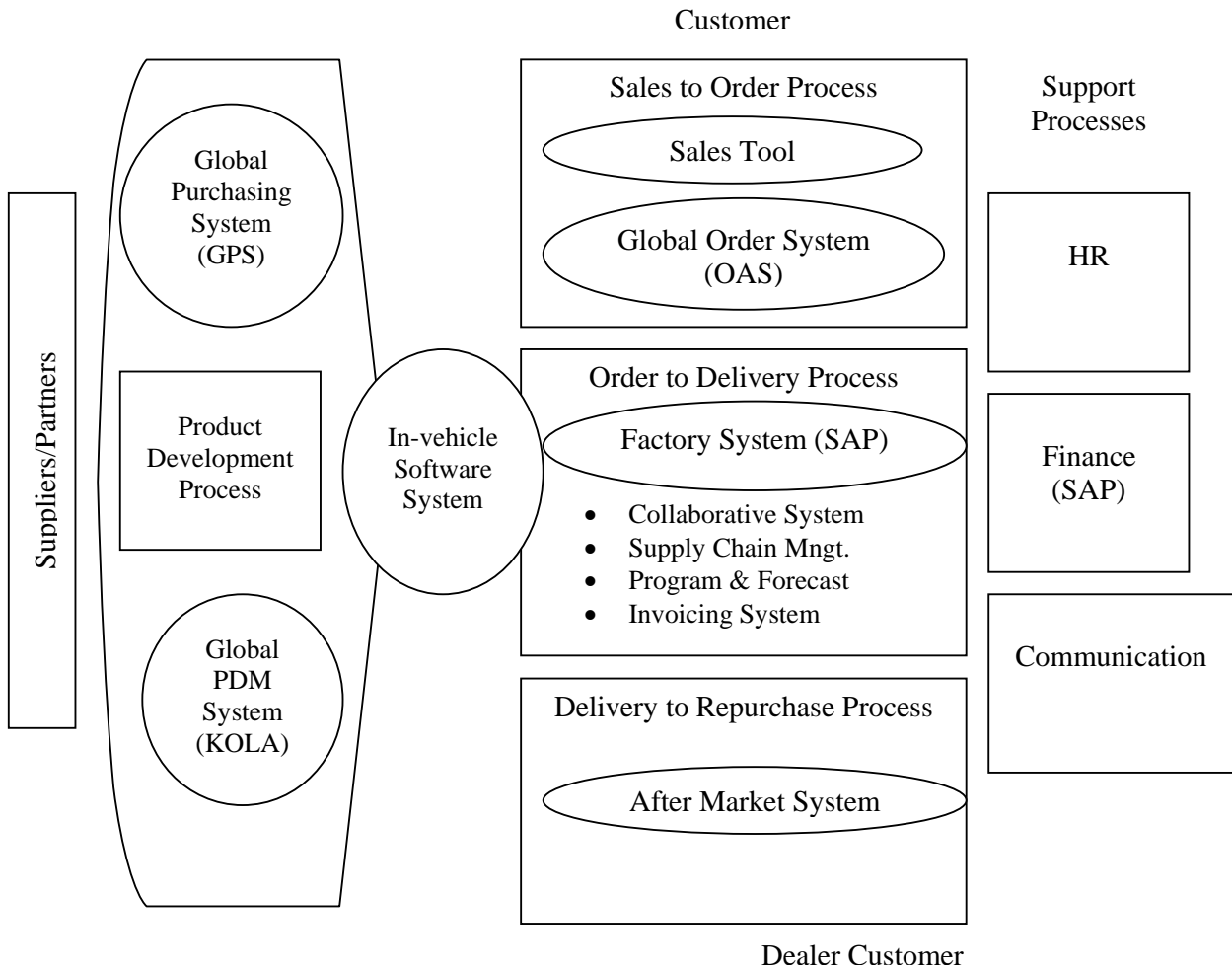
Source: Jack & Gibbins, 2002

Appendix 11-12 Mexico: Actual & forecast Bus & Coach sales 2005

Mexico: actual and forecasts Bus and Coach sales to 2005 (units)*									
	1997	1998	1999	2000	2001	2002	2003	2004	2005
Diesel Nacional	2,511	1,878	1,600	1,400	1,200	1,000	800	800	800
MASA/Volvo	477	959	800	1,000	1,000	1,100	1,200	1,200	1,300
Mercedes-Benz	2,634	2,406	2,200	2,300	2,400	2,550	2,600	2,700	2,800
Omnibuses integrals	429	1,035	1,000	1,050	1,100	1,200	1,250	1,300	1,300
Scania	282	753	600	700	750	800	850	900	900
Others	10	75	140	200	250	250	300	300	300
TOTAL	6,343	7,106	6,340	6,650	6,700	6,900	7,000	7,200	7,400

* figures from 1997-1998 are actual; the remainder are forecasts, Source: Jack & Gibbins, 2002

Appendix 11-13 IT Structure – To be complete Bus system



Source: Thomas Fransson, Chief Information Officer Volvo Buses, 2003

Appendix 11-14 Link between Issues and Competitive Priorities

Cost Efficiency	Quality	Delivery	Flexibility	Competence & Capability Development	Dependability
Production volume					
Exact costs breakdown					Exact costs breakdown
Overhead costs					
Customs duties and taxes		Customs duties and taxes			
Future investments			Future investments	Future investments	
	Systems used with Sweden				Systems used with Sweden
	Transfer of data		Transfer of data	Transfer of data	Transfer of data
	Manual procedures	Manual procedures	Manual procedures	Manual procedures	
	Systems handling		Systems handling	Systems handling	
Direct contact with suppliers	Direct contact with suppliers	Direct contact with suppliers	Direct contact with suppliers	Direct contact with suppliers	Direct contact with suppliers
Purchasing Agreements		Purchasing Agreements		Purchasing Agreements	
Delivery & Lead Times	Delivery & Lead Times	Delivery & Lead Times	Delivery & Lead Times	Delivery & Lead Times	
Readiness level		Readiness level		Readiness level	
	BOM	BOM	BOM	BOM	BOM
Logistics	Logistics	Logistics			
Material	Material	Material	Material	Material	Material
	DCN	DCN	DCN	DCN	DCN
Personnel				Personnel	Personnel
Training	Training	Training	Training	Training	Training

Source: Authors own elaboration