



UNIVERSITY OF BORÅS  
SCHOOL OF ENGINEERING

## **Warehousing in theory and practice**

*A case study at ÖoB, Clas Ohlson, Stadium, Åhlens*

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Mahesh Kumar Rajuldevi

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## **Abstract**

The problem in the warehouses is that the old and conventional methods which are obsolete are combined with very crowded conditions. Hence there is always a quest for newer and better methods. However, merely installing the newer methods does not mean that the system is effective and efficient, there is also necessity of a strong supervisory organization of the system to make the methods more effective and this also requires lot of training and managing the operations.

The purpose of this thesis is to give an overview and to briefly present the concept of warehousing. Analysing the present situation in warehouses by examining four of the biggest retail warehouses in Sweden with the help of a questionnaire given to the respective warehouse managers. Comparing the present situation to the theoretical framework in order to get an idea of the strategies deployed by the businesses.

The warehouses today are deploying a mixture of both latest strategies and technologies and the traditional methods in order to have a good efficiency in the warehouses.

**Keywords:** Warehousing, Warehouse Management systems, Retail stores, Inventory, Labour Management.

## **Abbreviations**

JIT	- Just In Time
WMS	- Warehouse Management System
RFID	- Radio frequency Identification
ÖoB	- Överskottsbolaget
CSCMP	- Council of Supply Chain Management Professionals
SCM	- Supply Chain Management
DSD	- Direct Store Delivery
3PL	- Third Party Logistics
ISO	- International Organization for Standardization
ROI	- Return on Investment
AWA	- American Warehouseman's Association
AS/RS	- Automated Storage/Retrieval Systems
AGVS	- Automated Guided Vehicle Systems
SKU	- Stock Keeping Unit
TMS	- Transportation Management System
LMS	- Labour management system
KPI	- Key Performance Indicator
RF	- Radio Frequency
PC	- Personal Computer
ERP	- Enterprise Resource Planning
LCD	- Liquid Crystal Display
DIY	- Do It Yourself
Auto ID	- Automated Identification
LAN	- Local Area Network
RF/DC	- Radio Frequency Data Communication
MIS	- Management Information System
MRP	- Material Requirement Planning
ASN	- Advance Shipping Notice
EDI	- Electronic Data Interchange
LIFO	- Last In First Out
FIFO	- First In First Out
S/R	- Storage / Retrieval
I/O	- Input / Output

SC	- Single Common
PTS	- Picker to Stock
STP	- Stock to Picker
WKPI	- Warehouse Key Performance Indicators
QR	- Quick Response
ECR	- Efficient Consumer Response
TQM	- Total Quality Management
XML	- Extended Mark-up Language
CRT	- Cathode Ray Tube
OCR	- Optical Character Recognition
UPC	- Universal Product Code
US	- United States
IBM	- International Business Machines Corporation
2 – D	- Two Dimensional
RS	- Recommended Standard
USB	- Universal Serial Bus
IEC	- International Electro-technical Commission
UID	- Unique Item Identifier
FMCG	- Fast Moving Consumer Goods
DC	- Distribution Centre
IFF	- Identification Friend or Foe
IC	- Integrated Circuit
HFID	- High Frequency Identification
UHFID	- Ultra High Frequency Identification
RAM	- Random Access Memory
ICC	- Integrated Circuit Card
PVC	- Poly Vinyl Chloride
SAP	- Systems, Applications and Products in Data Processing
AB	- Aktie Bolaget
SEK	- Swedish Krona
IFS	- Industrial and Financial Systems
VMI	- Vendor Managed Inventory
EU	- European Union
IGDS	- Intercontinental Group of Departmental Stores

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# **1. INTRODUCTION**

This chapter will introduce the reader to the background of this master thesis. Initially, an introduction to warehousing, essence, evolution and importance of warehousing concept is discussed which is followed by problem discussion. Finally the purpose, limitations are also discussed.

## **1.1. Background**

Human being has been in the business and commerce from several thousand years in one way or the other. It is only the last twenty five years that there has been a very drastic advance in the science of warehousing. In the present competitive world, the new warehousing ideas are becoming obsolete by the time the infrastructure is being arranged to implement the new ideas. This is the phase of the warehousing industry nowadays in which an organization should strive to be more efficient and effective than the other competitors. They must implement some sophisticated technologies very effectively in order to stay in the competition.

Warehousing is basically a function of storing goods in between the time they are manufactured and the time they are delivered to the customer. In practice, the goods are produced in long production runs and they are shipped to in large lots to the storage areas or warehouses closer to the market. In the post second world war period, the general trend for the supplier has been to store the goods in order to meet the demand in the market which is always fluctuating. The delivery time has been very essential tool for the businesses as a marketing technique. The idea has been to provide shorter lead times instead of reducing the price in order to attract the customers. This marketing strategy is one of the main reasons for the rapid growth of the concept of warehousing globally.

The problem in the warehouses is that the old and conventional methods which are obsolete are combined with very crowded conditions. This may result in very slow material movement and this leads to increase in inventory holding costs and also increase in the operating costs. The businesses will not tolerate this increase in costs; hence there is always a quest for newer and better methods. However, merely installing the newer methods does not mean that the system is effective and efficient, there is also necessity of a strong supervisory organization of the system to make the methods more effective and this also requires lot of training and managing the operations.

In this thesis work, we look into the concept of warehousing very briefly according to the theoretical perspective and then we examine the warehouses in the real world in order to get an insight of the warehouses and the strategies they are adapting in order to work effectively and efficiently and at the same time reduce the overall costs, which are very prominent in maintaining a warehouse and the inventory in the warehouse. (Tompkins, Smith, 1998).

## **1.2. Problem discussion**

The traditional warehousing technique is becoming obsolete since the last decade of the 20th century with introduction of some of the sophisticated techniques such as JIT, deployment of WMS, development of automation and control systems, deployment of

goods identification techniques like RFID, voice picking etc. These new developments specially designed to enhance the return on investment of the businesses by optimizing the inventory levels and help in reducing the overall warehousing costs.

JIT can be best described as an inventory strategy to enhance the return on investment by decreasing in-process inventory and its related carrying cost .JIT concept is based on delivering the product directly from the supplier to the retail outlet and shelf the products in the retail store eliminating the concept of warehousing which is now becoming more prominent in the businesses because there is a drastic reduction in the costs of the businesses by eliminating the warehouse thus eliminating the inventory holding costs. As the distance between the supplier and the retailer increases, it builds up the need for a warehouse in between the geographical regions to reduce the transportation costs and to add some value adding activities to the products. There are also some other advantages such as consolidation and pooling if a warehouse is located between the supplier and the manufacturer.

Some of the recent developments in the warehousing led to the development of new warehousing concept called a “Retail Warehouse”. In a retail warehouse, the floor space is used for warehousing as well as the retail store. These types of warehouses are equipped with tall racks and the items which are ready for sale are placed at the bottom of the racks and the products which are wrapped, packaged and palletized are placed in the top parts. This concept cuts down the costs involved in warehousing and eliminates the total concept of warehouse.

Despite the emerging new technologies in e-commerce, supply chain integration, quick response, just-in-time delivery and efficient consumer response that connect the manufacturing with the end customers, businesses are still struggling to eliminate the existence of a warehouse. Thus in order to meet the customer’s requirements warehouse needs to be properly coordinated and maintained with par to recent technologies.

Now that there is no replacement for a warehouse in the present circumstances, the need for a warehouse to be managed very effectively rises and to perform the operations inside a warehouse with much efficiency and in turn reduce the storage time and costs involved in the storage is essential for the businesses. These targets cannot be achieved by blindly adapting and deploying the new trends and technologies. There is a need to optimize the technology and the manpower in order to get good results and high efficiency.

In spite of having drastic developments and latest sophisticated technologies in the field of warehousing, there is always a speculation for the organizations of which strategy should be adapted in order to gain maximum efficiency and at the same time reduce the costs involved in warehousing. The decision making of the administration and the management for a business is very critical and this must be done with utmost care in order to get paybacks in really less time period. The decision to choose the right strategy and the right technology for the businesses is very crucial and this is a very challenging task to perform in the present circumstances. The new technology deployed should increase the throughput and efficiency of the system and at the same time reduce the costs and reduce the time taken to perform that respective operation.

The present warehouses are in the situation, where there is a speculation of which strategy can give the warehouses the best results and the warehouse managers are very sceptical and apprehensive over the use of the latest technologies or the traditional warehousing methods in order to maintain the warehouse efficiently at the same time gets good results for the organizations.

This thesis work gives an insight of the traditional as well as the latest advances and trends in technology in the field of warehousing and it also gives us a glance of today's warehouses and how they perform their operations. The terminology of "Warehouse" concept is discussed very briefly in order to get an idea of all the operations performed in the warehouse and the technological advances available in the present market. (Tompkins, Smith, 1998).

### **1.3. Purpose of this study**

The purpose of this thesis work is to give an overview and to understand deeply the concept of "Warehousing", which is defined and interpreted in theory and practice. In order to get an overview, both theoretical and empirical studies are conducted. The theoretical study is conducted by carrying out a research work on relevant literature through textbooks, scientific articles, internet etc. In the empirical study, we investigate the present state of the warehouses and examine whether the case companies utilize the practices that the literature points out based on theoretical background. The empirical study is implemented by interviewing warehouse managers of four firms with the help of a questionnaire.

#### **1.3.1. Theoretical objectives:**

- To give an overview and to briefly present the concept of "Warehousing".
- Emphasize on various terms related to warehousing and also to examine all the operations which are performed in a warehouse.
- Examine latest technologies available in Warehousing and discussing the pros and cons of the available technologies.

#### **1.3.2. Empirical objectives:**

- Analyse the present situation in warehouses by examining four of the biggest retailers warehouses in Sweden i.e. ÖoB, Clas Ohlson, Stadium, Åhlens with the help of a questionnaire given to the respective warehouse managers.
- Comparing the present situation to the theoretical framework in order to get an idea of the strategies deployed by the businesses.

### **1.4. Target groups**

This thesis will give a theoretical basis of the whole concept of warehousing for the academic world and mainly targeted towards the people studying logistics and supply chain management or any subject related to warehousing and people who need some guidance in the terminology within the field of warehousing.

## **1.5. Limitations**

- The thesis work analyses the purpose through the perspective of the individual firm and this research work solely looks into the internal functions within a company excluding the external environment as much as possible.
- The warehouse managers were very helpful in the interviews conducted in all aspects but some questions were left unanswered in the better interest of the companies due to some constraints of the businesses and company policies.
- The empirical study is limited to only four companies which are located in and around Borås.
- The research work is mainly constrained to qualitative study and very less work based on quantitative approach is performed.

## **2. METHODOLOGY**

This chapter deals with the methods followed in order to write the thesis and also to give the reader an overview of the methodology of the thesis work carried out in writing thesis work. This chapter presents an ideology and concepts of different research strategies, main scientific and research approaches. Further, the two major sources for the information collection are presented which also includes the issues of credibility. Finally, the methods which are relevant to this thesis work are also explained briefly.

### **2.1. Research strategy**

There are mainly two types of approaches in writing a thesis work i.e. a theoretical or an empirical one. The theoretical approach requires very intensive textual investigation and the empirical approach requires extensive communication and interaction with people. Our aim is to present a practical case which is based mostly on the theoretical studies. This thesis mainly pays emphasis on the practical approach and at the same time to make it possible, a good theoretical background is a pre-requisite. Firstly, we will review the literature present in theoretical frame of reference and try to define a theoretical foundation. We then shift to the empirical approach and have a glance of how the businesses work in the real world and what are the problems they face on a daily basis. This will be performed by interviewing the warehouse managers in ÖoB, Clas Ohlson, Stadium and Åhlens with a questionnaire. (Kumar; Research methodology, 2005).

### **2.2. Scientific perspective**

A paradigm represents people's value, judgment, norms, standards, perspectives, ideologies, myths, theories, frames of reference and approved procedures that govern their thinking and action.

The epistemology or the theory of knowledge has two different scientific paradigms i.e.

1. Positivistic paradigm
2. Hermeneutic paradigm

These both approaches are in contrast with each other and they define two entirely different perspectives of research methodology. (Kumar; Research methodology, 2005).

#### **2.2.1. Positivistic paradigm**

This refers to the school of thought that the only available truth or the valid form of knowledge is the one which is "Scientific", objective and tangible in nature. The positivistic approach basically is theory based and depends on description and explanation. The theories give a very strong framework based on discussions and deductions. The research is performed on the basis of rational, logical and reasonable approach which is very systematic and it is used through a cause and effects relationship. The concepts such as feelings, emotions, and beliefs are not accepted in this approach because they are not objective or tangible, and due to the fact that they are not reliable and constant over time. The approach mainly aims at critical evaluation of all the



statements from facts which can be validated or guaranteed with certain probability. The knowledge is attained by verifying and falsifying hypothesis and theories which lead to objective and true knowledge.

### **2.2.2. Hermeneutic paradigm**

This approach is based more on the personal interpretative process to understand reality. The concepts such as feelings, emotions, perspectives, opinions and so on are the basis of this paradigm. These are measured using words, statement and other non-numerical measures, collecting data from the perspective of the participant. The data collected is then interpreted by the researcher who attempts to uncover the meanings, values and explanations. According to this approach knowledge is acquired through understanding and it sees no difference between the observer and the investigated subject.

The overall structure of our research work is based on Positivistic paradigm starting with the construction of theoretical frame of reference and then empirical information collection. Since the positivistic approach is theory based, a lot of emphasis is paid to construct the theoretical framework and then comparing the theory to the empirical findings which are acquired from personal interviews with the respective warehouse managers with the help of a questionnaire.

There are two ways of coming to the conclusions i.e. Induction and Deduction.

### **2.2.3 Induction**

This method is basically finding conclusions based on the empirical facts which are collected. This approach states that induction presupposes quantification and it is often emphasized that the data collection should occur unprejudiced. However, in this approach a statement can only be found more or less probable, but it is never hundred percent certain. Due to the fact that there is a direct connection to reality, the terms validity and reliability are very important factors when using induction. It is also possible to base an inductive approach exclusively on the empirical findings.

One drawback of this approach is that the theory doesn't contain anything more than the empirical findings. One more drawback is that when performing a study there is always some selection and collection of theoretical frame of reference, which indicates that the approach is not totally unprejudiced.

### **2.2.4 Deduction**

This method is based on the logical conclusions rather than the empirical data which are regarded as true if a consistency is maintained throughout the study. However, in contrast to the induction method these conclusions are not forcedly true compared to reality. The origin or the base point for every deductive method is the theory behind it. Based on this theoretical knowledge certain predictions are made on the empirical data. The goal then is to find some data which supports the predetermined predictions made

based on the theory. The theory decides what information should be collected, how it should be interpreted and finally how the result should be related to the existing theory.

The present thesis work mainly is based on the deductive approach in which initially a theoretical frame of the warehouse management, its working etc. is constructed and then this is compared to the empirical findings which are collected from the personal interviews of the warehouse managers of four organizations i.e. ÖoB, Clas Ohlson, Stadium and Åhlens with the help of a questionnaire designed mainly on the operations of the warehouses.

### **2.2.5. Quantitative data**

This type of data includes information which can be measured numerically. This can be called as hard data such as profit in dollars, unsold units etc. The quantitative studies are considered to be more precise and they give better possibility for generalization than the qualitative studies.

### **2.2.6. Qualitative data**

This type of data is more sensible and creates deeper understanding of a specific research area and answers questions like 'Why'. This is considered as soft data and it consists of information such as the comfort levels of an employee on the shop floor etc.

This type of data aims at capturing qualities which are neither quantifiable nor reducible to numbers such as feelings, thoughts, opinions and experiences. This approach is basically interpretive approach to knowledge and relies heavily on the verbal data and subjective analysis and has very less use of numbers and statistics.

As far as our thesis work is concerned, the data collected is more or less qualitative in nature which is collected using a questionnaire. Although there are some questions in the questionnaire which start with "How many", "How much" etc, the only intention of the research is to have a comparison and the data collected is not used to perform any statistics. Therefore the thesis work is mainly a qualitative one in spite of having some numerical values on some occasions.

## **2.3. Data collection**

The data used for a research work can be collected from several sources. The data which is used for both theoretical as well as the empirical approach can be collected from various sources such as archival records, interviews, observations, physical artefacts etc. This collected data can be basically divided into two different types, primary and secondary data. (Kumar; Research methodology, 2005)

### **2.3.1. Primary data**

The primary data implicates the collection of information through direct observation, personal interviews, questionnaire and conducting conversation. This is basically the data collected by the researcher during the project which is only used for the project for the research work. The basic requirement for this work is that there is no previous documentation on the ongoing research work. This data is very important to create an understanding for an individual project. However, when there is a need to have more universal and general patterns, the primary data is not that important.

### **2.3.2. Secondary data**

The secondary data means the study of documents, biographies, websites, textbooks, scientific articles and other historical and documentary records which are relevant for the research study. This type of data can be assembled from already existing documentation. Basically all the data which is collected for a specific research area is called secondary data. This data helps in giving important background information about the research area.

In our research study, we used primary as well as the secondary information to support our thesis work. The primary data came from the interviews and the questionnaire which we have designed for the interviews. The warehouse managers were kind enough to answer most of the questions in the questionnaire and we have got lots of valuable information about warehouse management. The secondary data about the research area was mainly gathered from some of the textbooks based on warehouse management and some of the theory was also collected from many scientific articles related to the research topic.

## **2.4. Validity**

Validity describes the extent to which the results correspond to the reality. The connection between the theoretical and the empirical areas is known to be difficult, but it must be present in some way or the other. This connection is called Validity which means measuring what is really supposed to be measured. One way of increasing the validity is to use various perspectives during the study.

Validity is divided into two parts Internal and External validity. The internal validity deals with the direct connection between the theoretical framework and the empirical study. This means that the experiments or the interviews should be performed with relevant people who are competent and qualified and the experiment should have enough samples to support the research study.

All the interviews and conversations during this research work were performed with relevant people who were extremely experienced, knowledgeable and highly qualified. The designation of the interviewees was high and all of them were warehouse managers (Varuhus Chef) who were very much competent, vastly experienced and extremely qualified.

The external validity concerns the study with all its contents in a wider perspective i.e. possibility of generalization from the research work. Our thesis work may be fruitful since this is a comparison between the theories and what really happens in the real world, the results and conclusions may be very helpful for the reader to understand the concepts very easily. (Kumar; Research methodology, 2005).

## **2.5. Reliability**

If in the future, any investigation is carried out on the same topic and the investigation follows the same procedure as described by the previous researchers and if the same study is repeated in the same way, and if the results are same with same findings and similar conclusions, then the research work is said to be reliable. Reliability depends on the accuracy of the techniques. Some of the things which can make the reliability low in the research studies are wrong samples, problems in interpretations and problems with standardization in the interviews etc.

In our research work, we have interviewed four of the warehouse managers who belong to ÖoB, Clas Ohlson, Stadium and Åhlens. The managers are highly qualified and competent and have extensive knowledge in the area of our research work. Moreover, the research work is done following the basic format of research study and followed a genuine and systematic procedure throughout this thesis work. Due to these facts, we assume that our thesis work is reliable and is performed on the basis of a standard research framework. . (Kumar; Research methodology, 2005).

### **3. THEORETICAL FRAME OF REFERENCE**

In this chapter, theories related to the research issues which are relevant to the present thesis work are described. The theoretical framework for Warehousing is briefly set up discussing all the important factors related to warehousing.

The purpose of this part of the thesis work is to set up a basis for theoretical frame of warehousing concepts and investigate whether the technological advantages and the theoretical benefits are likely to create some impact on the efficiency of the companies and also to find out whether they create some real added value for the companies.

#### **3.1. Logistics**

“Logistics is the management of the flow of goods, information and other resources, including energy and people, between the point of origin and the point of consumption in order to meet the requirements of consumers. Logistics involve the integration of information, transportation, inventory, warehousing, material-handling, and packaging” (Wikipedia).

“Logistics is defined as the planning, organization, and control of all activities in the material flow, from raw material until final consumption and reverse flows of the manufactured product, with the aim of satisfying the customer’s and other interest party’s needs and wishes i.e., to provide a good customer service, low cost, low tied-up capital and small environmental consequences” (Jonsson, Mattsson, 2005).

“ Logistics is defined as those activities that relate to receiving the right product or service in the right quantity, in the right quality, in the right place, at the right time, delivering to the right customer, and doing this at the right cost (The seven R’s)” (Shapiro, Heskett, 1985).

In most of the cases logistics is seen from the perspective of an operative way of transporting or moving materials from one point to another or producing service. The credibility of this operation is based on how good is the design of the system that leads to this kind of logistics.

“Logistics systems encompass operative responsibilities, which include administration, operation and purchase and constructive duties as well as detailed design” (Lumsden, 1998)

“Logistics management is that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customer’s requirements. Logistics management activities typically include inbound and outbound transportation management, fleet management, warehousing, materials handling, order fulfillment, logistics network design, inventory management, supply/demand planning, and management of third party logistics services providers. To varying degrees, the logistics function also includes sourcing and procurement, production planning and scheduling, packaging and assembly, and customer service. It is involved in all levels of planning and execution – strategic, operational, and tactical. Logistics management is an integrating function which

coordinates and optimizes all logistics activities, as well as integrates logistics activities with other functions, including marketing, sales, manufacturing, finance, and information technology.” (Logistics Management, council of Supply Chain Management Professionals CSCMP, 2004).

### 3.2. Supply chain management

“Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies. Supply Chain Management is an integrating function with primary responsibility for linking major business functions and business processes within and across companies into a cohesive and high-performing business model. It includes all of the logistics management activities noted above, as well as manufacturing operations, and it drives coordination of processes and activities with and across marketing, sales, product design, finance and information technology.” (Supply Chain Management, SCM, Council of Supply chain Management Professionals, CSCMP, 2004)

“Supply chain management is defined as the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole” (Mentzer, 2001).

#### 3.2.1. Supply Chain Management Problems

- **Distribution Network Configuration:** Location and network missions of suppliers, number of distribution centers, production facilities, cross-docks and customers, warehouses.
- **Distribution Strategy:** Including questions of centralized operating control and decentralized or shared operating control , delivery scheme which constitutes direct shipment, pool point shipping, cross docking, direct store delivery(DSD), closed loop shipping, mode of transportation (Intermodal, airfreight, ocean freight), replenishment strategy which has pull, push and hybrid and transportation control (3PL, private carrier, common carrier, contract carrier) . (Wikipedia)

The above operations should be dealt well in order to reduce the total logistics cost. Trade-offs always exist which increase the total cost if only one of the above operations is optimized. Trade-offs are important in developing the effective and efficient logistics and SCM strategy. It is mandatory to take a systems approach when planning the logistical activities.

- **Information:** Integration of all the processes through the supply chain in order to share valuable information, which includes forecasts, inventory, transportation, and potential collaboration.

- **Inventory Management:** Location of inventory including raw materials and quantity, work-in-process and finished goods.
- **Cash-Flow:** Providing methodologies for exchanging funds across entities within the supply chains and also arranging the payment terms

In short the Supply chain execution is defined as managing and coordinating the movement of materials, information and funds across the supply chain. The flow is considered to be bi-directional. (Wikipedia).

### 3.3. Warehouse

Warehouses are usually large plain buildings used for commercial purposes for storage of goods. Warehouses are commonly used by exporters, importers, wholesalers, manufacturers etc. Warehouses are usually equipped with loading docks to load and unload trucks and they have cranes and forklifts for moving goods, and are placed on ISO standard pallets loaded into pallet racks. (See fig 3.1)

Some warehouses are fully automated where products are moved from one place to other with a system of automated conveyors and automated storage and retrieval machines which run by programmable logic controllers and also with logistics automation software. In an automated warehouse the tracking of materials is coordinated by warehouse management system (WMS), a database driven computer program. Logistics personnel make use of WMS to improve the efficiency of the warehouse by maintaining accurate inventory levels taking into consideration warehouse transactions and directing put ways.

Traditional warehousing continuously is declining since the last decade of the 20<sup>th</sup> century with the introduction of Just in Time (JIT) techniques which are specially designed to enhance the return on investment (ROI) of a business by mitigating in-process inventory. JIT concept is based on delivering product directly from the factory to the retail outlet without the use of warehouse, but in some cases like offshore outsourcing and off shoring in about the same time period, the distance between manufacturer and the retailer increases considerably in many regions which builds the need of at least one warehouse per region or per country for a given range of products in any typical supply chain. (Tompkins, Smith, 1998).

Recent developments in marketing field have led to the development of warehouse designing style, where the same warehouse is used for warehousing and also as a retail store. These types of warehouses are equipped with tall heavy duty industrial racks, with the items which are ready for sale are placed in the bottom parts of the racks and the palletized and wrapped inventory items being usually placed in the top parts.

Exporters/manufacturers are using warehouses as a point of developing retail outlets in a particular region or country. The above concept cuts down the end cost of the product to the consumer which in turn enhances the production sale ratio. Warehousing concept is used as a sharp tool by manufacturers to reach directly to consumers by avoiding or bypassing importers or other middle agencies. (Tompkins, Smith, 1998)

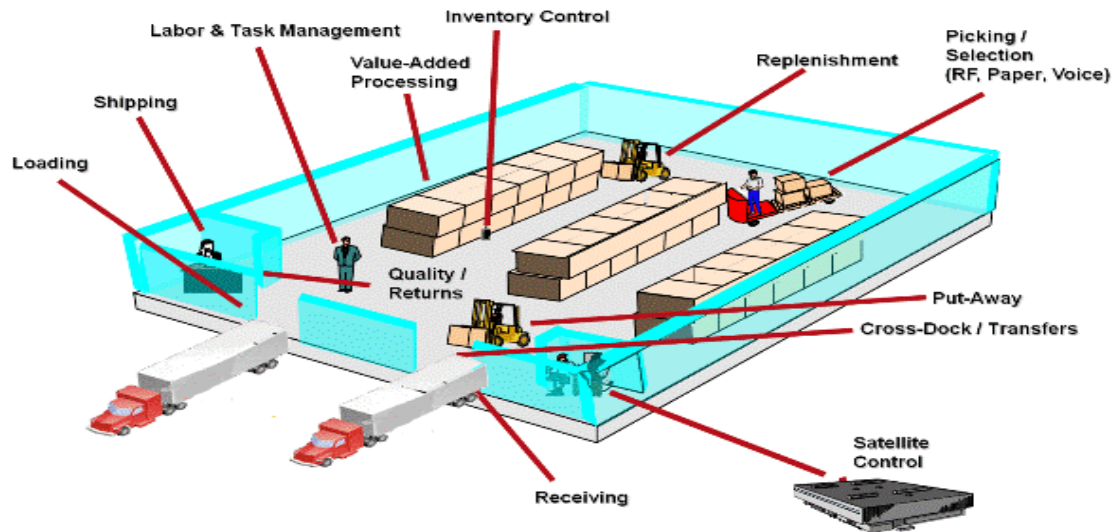


Figure 3.1 Structure of a Warehouse (Source: armitage.com)

### 3.3.1 Why have a warehouse

Despite the new technologies in e-commerce, supply chain integration, quick response, just-in-time delivery and efficient consumer response that connect the manufacturing with the end customers, businesses are still struggling to eliminate the existence of a warehouse. Thus in order to meet the customer's requirements warehouse needs to be properly coordinated and maintained. (Cooper. J.C, Davis. Matthew, 1984)

## 3.4. Types of warehouses

**Raw material and component warehouses:** It hold raw materials and always in a position to induct raw materials onto a manufacturing or assembly process.

**Work-in-process warehouses:** This warehouses hold partially completed products and assemblies at various points along production line or an assembly line.

**Finished goods warehouses:** It holds inventory usually to balance the variation between production schedules and demand. Normally these warehouses are situated near manufacturing plant, and it is characterised by the flow of full pallets in and full pallets out, assuming the product size and volume authorizes pallet-sized loads.

**Distribution warehouse and distribution centres:** Distribution warehouses accumulate products from various manufacturing points for combined shipment to the common customer. Normally, the warehouses are located central to either the production locations or the customer base. Product movement represented by full pallets or cases in and full case or broken case quantities out.



**Fulfilment warehouses and fulfilment centres:** It receives, pick, and ship small orders for individual consumers.

**Local Warehouses:** These warehouses mainly for the purpose of responding to the customer demand. Frequently, single items are picked, and the same item is shipped to the customer every day.

**Value-added service warehouses:** Key product customization activities takes place like packaging, labelling, marking, pricing, and returns processing.

There is also one more classification of warehouses according to which geographical area they cater to:

- Centralized warehouse
- De-centralized warehouse

**Centralized warehouse:** Centralization generally refers to the allocation of the warehousing services to one particular business unit which provides services to the whole firm. The decisions are made at the central location for the entire network. The main characteristics of a centralized approach are control, efficiency and good economy.

Benefits:

- Improvement in productivity through balancing
- Increase in available knowledge
- Bundling of product flows
- Combined use of production flows
- Control on the system
- Uniformity in the processes
- Improved efficiency

Limitations:

- Customer desire of self pickup cannot be provided
- Problem of concentration of customers in only certain markets and inhomogeneous customer structure
- Long internal transport paths in large central warehouses and higher costs for the infrastructure
- Slow process of decision making, less flexibility
- High initial costs
- Bureaucracy in the system
- Inflexibility
- Dependent systems

**De-centralized warehouse:** Decentralization approach gives the individual business units autonomy and independency over their own resources without any major considerations over the remaining units unless there is a necessity for the overall organization policy. In this approach each facility identifies its most effective strategy without considering the impact on the remaining facilities in the network and this leads to the local optimization. The main characteristics of the decentralized approach are empowerment of individual business units, flexibility, and service orientation. They provide as good service as the centralized warehouses in terms of customer service level.

Benefits:

- Rapid adjustment to the changes
- Flexibility
- Quality
- Innovation
- Low startup costs
- Customization and catering to individual needs is possible
- Increase in responsiveness
- Improvement in reliability

Limitations:

- Lack of centralized control
- Duplication of resources
- Extensive use of effort and expertise
- Increase in costs (Tompkins, Smith, 1998), (Mulcahy, 1994)

### **3.5. Today's warehouse requirements**

- Execute more, smaller transaction
- Handle and store more items
- Provide more product and service customization
- Offer more value-added services
- Process more return
- Receive and ship more international orders

At the same time, warehouses today have

- Less time to process an order
- Less margin for error
- Less young, skilled, English-speaking personnel
- Less WMS capability (Tompkins, Smith, 1998).

### **3.6. Problem areas in Warehousing**

Warehouse management was considered to be very simple to handle in earlier days when everything was performed manually. The biggest problems then were the bar codes and space utilization in the warehouse. There has been drastic change in today's Internet world, after the outbreak of this internet technology everything was looking even simpler than the earlier days with more efficiency and consumption of less time and gaining a competitive advantage with potential economical savings. The evolving technology changed the warehousing methods a lot with logistics being carried out a quicker pace and with very little scope for error. Although there are many technologies evolving everyday, many problems are also arising making Warehousing more complex. This in turn is affecting the whole supply chain management. (Hompel, Ten., Michael., Schmidt, Thorsten., 2007)

The following are some of the problems being faced by today's warehouses:

i) Automate all the mechanized or manual operations ii) Satisfy the requirements of the customer without much customization iii) Integration of the warehouse data with supply chain applications iv) Compatible to the cost- effective global supply chain

### **3.7. History of warehousing**

The warehousing concept takes us way back to the creation of granaries to store food, which was stored for drought and famine and this food was available for purchase in the conditions of emergency, famine, drought etc. As the European explorers began to discover new shipping trade routes all over the world, the importance of warehouses grew for the storage of products and commodities which were brought from far way places. The ports were the main locations of the warehouses, since majority of the trade between the countries was carried by ships.

In early days man used to store excess food and keeping animals for emergency surplus. As the civilization developed, local warehouses were introduced. Normally merchandise is stored in connection with shipping, trading, and manufacturing activities. During the Middle Ages improvement in human knowledge gave rise to warehousing to handle the storage of shipped items. The first known major commercial warehouse was built in Venice, a centre of major trade routes. In late 1800's in the United States, transportation between port cities and inland cities were effectively provided by railroad. Freight cars were used as warehouses on wheels, and were especially used in grain harvest season. Shortages in freight cars induced the railroad companies to partition the transportation and warehousing functions. During this time period because of monopoly on both warehousing and freight by railroad companies favoured large corporations, giving them free warehousing services with the use of the railroads. The warehousing facility was provided as an additional service to transportation, and the service so provided was part of the clearance terminal. The word terminal describes the warehouses were located in the centre of the city, normally close to the wholesale market district and railroad depot. (Tompkins, Smith, 1998).

By the end of World War I, hand trucks were used for material handling in warehouses and stacking was done by hand, and stacking heights were designed in 8-to 12-foot range. During World War II, the fork lift truck and wooden pallets were introduced. Stacking height of merchandise was increased to 30 feet, nearly a 300 percent increase due the mass production of forklift truck.

Warehousing systems have seen a continuous growth throughout the history, they have been moving forward from local storehouses during the middle ages to multimillion-dollar facilities. In 1960s and 1970s in the US automated warehousing meant automated storage/Retrieval systems (AS/RS). The main factor which gave rise to this development was the doubling of the value of business inventories between 1962 and 1972 and the value was tripled between 1972 and 1982. After the late 1980s the AS/RS systems became obsolete and more emphasis was paid on reducing inventories, small batch production and Just in time delivery. (Tompkins, Smith, 1998).

### **3.8. Changing trends of warehousing**

Due to the changing trends in the businesses, warehousing and distribution operations should adopt to the emerging changes and growing needs of the customers. The term 'Globalization' brought rigorous changes in the field of logistics. The distribution operations now pay more emphasis on fewer inventories, smaller order sizes, larger SKU catalogues, quicker order turnaround, increased customized packaging and value adding services. Once the businesses concentrated only on local distribution centres and now all the companies give more importance on having more globalized distribution centres, and instead of having single network channel, they are having multiple distribution channels.

In order to cope to these changing trends every second, most of the companies have deployed new technologies such as Warehouse management systems (WMS) and Transportation management systems (TMS) and some have decided to redesign the processes and facilities to meet the emerging requirements as well as to reduce costs and improve service levels to the customers at the same time. Some large scale businesses have gone one step ahead and decided to deploy automation of the whole warehousing operations. Some have already opted to outsource all their warehousing operations to third party logistics provider (3PL). (Hompe, Ten., Michael., Schmidt, Thorsten., 2007).

Development of automation and control systems

- Moving beyond the hype of RFID
- Training of employees
- 3PL providers:
- Driving towards centralization of warehouses
- Alternative picking methods
- Extending supply chain software
- Focus on profitability and accountability

### **3.9. Retail warehousing**

Retail warehouse is the concept of selling the goods in the warehouse itself. In this kind of warehousing the goods are on display in the warehouse for the immediate purchase by the consumer. It is a dynamic industry and the amount of floor space, type and location occupied by retailing is determined by the number of influences forced by the consumer, the developer, land use planner and the retainer. In the last 10-15 years there is a drastic change in the market needs, the dramatic decrease in the rate of growth of the population has given pace to population decentralisation. The growth of new companies and with the corporate rationalisation after post war period retail warehousing has become more common business concept. (Wikipedia)

#### **3.9.1. Need for Retail Warehousing and its growth**

The concept of the food retailing was introduced in late 1960's and it quickly spread to durable goods sectors, thus giving rise to the retail warehouse concept. It is referred to a single storey retail outlet that sells the non-food goods, with an estimated space of minimum 10,000 square feet of floor space, occupying a building of warehouse model and having car parking facility. In the recent times the warehouse floor space has increased slightly according to the goods being retailed. The floor space for the three

main types of retail warehouses is as follows, 10,000-15,000 square feet for electrical goods, 30,000-40,000 square feet for Do-It-Yourself (D-I-Y)/ home improvement centres and 40,000 to 50,000 square feet for furniture and carpets.( Henneberry, 1987)

### **3.10. Warehouse management system**

Warehouse management system is a pivotal part of the supply chain which mainly controls the storage and movement of materials within a warehouse and processes the transactions, including receiving, shipping, picking and putaway. WMS also enables in directing and optimizing stock putaway according to the real-time information of bin utilization status.

Warehouse management system works on Auto ID Data Capture technology, such as mobile computers, barcode scanners, wireless, RFID and LAN's to efficiently monitor the flow of products. In this process, data is collected and there is either batch synchronization, or wireless transmission to a central database in real time basis. Then the database provides the status of goods in the warehouse accurately. The main objective of WMS is to provide an automated (computerized) procedure to handle the records of incoming and outgoing goods. WMS provides a helpful link to logistics management and also for order processing in order to pick-up, packing and shipping the product out of the facility. (Wikipedia)

#### **3.10.1. WMS benefits:**

**Faster payback and Inventory returns:** WMS reduces the lead time by confining the movement of inventory and improve the inventory records accuracy, this leads to a system which supports the JIT environment.

**Efficient-Warehouse floor space utilization:** Warehouse management system can efficiently locate the items in relation to receiving, assembling, packing, and shipping point thus contributing to efficient use of warehouse space.

**Reduction in paperwork for inventory transactions:** WMS minimise the paper work which is associated with warehouse operations such as receiving, picking and packing by maintaining the data electronically, and also ensures the timely and accurate flow of information.

**Improvement in Cycle Counting:** WMS captures relevant data in order to schedule the personnel for cycle counts. These cycle counts can enhance the accuracy of inventory records for planning purposes, and also minimizes the need costly physical inventories.

**Reduced Dependency on Warehouse Personnel:** The operations such as picking methods, inventory movements and inventory locations can be standardized by implementing WMS. The above standardization results in lower training costs, lower error rate and minimizes reliance on informal practices.

**Enhanced customer service:** The process can be streamlined from order to delivery with the WMS implementation, and thus companies can accurately find product

availability and the realistic dates for delivery. WMS identifies and releases back-order inventory and thus minimizes returns due to the fact that shipment accuracy is improved.

**Improved labour Productivity:** Cross docking is another important aspect of warehouse management system where incoming shipments are routed to the location near to the outbound shipping dock, thereby reducing the warehouse handling. Thus material flow is optimized by WMS using cross docking function.

The above mentioned benefits which are achieved by WMS involve high cost for the organization to spend. WMS takes into account or uses all the advanced techniques in order to improve the warehousing activities and also contributes to the efficiency of the supply chain management against a very high cost. So it is very important to follow few steps while implementing WMS by the companies in order to control the cost involved in implementing it. (Hompel, Ten, Michael., Schmidt, Thorsten., 2007)

### 3.11. Warehousing functions



Figure 3.2 Warehouse functions (Source: [erp.net.au](http://erp.net.au))

### **3.11.1. Receiving**

It is the setup operation for all other warehousing activities. Receiving the merchandise properly is the key to warehouse operations, because it will create problems in put away, storage, picking and shipping, if the damaged or inaccurate deliveries are allowed into the warehouse then the same has to be shipped. (See fig 3.2)

Few world class receiving practices are

- i) Direct shipping ii) Cross-docking iii) Receiving scheduling
- iv) Pre-receiving v) Receipt preparation

### **3.11.2. Putaway**

Order picking in reverse is known as putaway. Most of the principles which enhance or streamline the picking process work well for putaway. Principles for putaway are

- i) Direct putaway ii) Directed putaway iii) Batched and sequenced putaway
- iv) Interleaving

### **3.11.3. Pallet storage systems**

- i) Block stacking ii) Stacking frames iii) Single-deep selective pallet rack
- iv) Double-deep rack v) Drive-in rack vi) Drive-thru-rack vii) Pallet flow rack
- viii) Push-back rack

### **3.11.4. Pallet retrieval systems**

The Most popular pallet retrieval systems are

- i) Walkie stackers ii) Counterbalance lift trucks iii) Straddle trucks
- iv) Side loader trucks v) Turret trucks vi) Hybrid trucks
- vii) Automated storage and retrieval (ASR) machines.

### **3.11.5. Case picking systems**

Case picking systems are organized into three categories

- i) Pick face palletizing systems ii) Downstream palletizing systems iii) Direct loading systems. (Briggs, 1978)

### **3.11.6. Unitizing and shipping**

The unitizing and shipping activities are classified as

- i) Container optimization ii) Container loading and void fill iii) Weigh checking
- vi) Automated loading v) Dock management (Briggs, 1978)

### **3.12. Warehouse layout to meet standards**

- i) Determining the overall space requirements for all warehouse processes.
- ii) specify a U-shape, straight-thru, or modular overall flow design
- iii) Locate functions with high adjacency requirements close to one another.
- iv) Assign processes with high storage requirements to high-bay space and labour intensive processes in low-bay space.
- v) Document expansion and contraction strategies for each warehouse process. (Briggs, 1978)

### **3.13. Warehouse management and supply chain management**

Warehouse management system is considered to be the key component in contemporary supply chain management .The instant growth in the market demand for warehouse management system which is a result of the dramatic changes in the way companies views the distribution pile line and its connected importance to gain and sustain the crucial competitive advantage.

The primary objectives of distribution and logistics systems are improved customer service, tighter control of inventories and reduced costs across all market sectors. Just-in-Time (JIT), supply Chain Management (SCM), Quick Response (QR) and efficient consumer response (ECR) are some of the concepts followed by companies in order to improve their performance

Present companies are very cautious about investing in large scale, automated or mechanized material handling solutions, opting for more flexible, fully conventional approaches that combine mechanized and conventional alternatives. These particular developments have led to the rapid growth of computer-based warehouse management systems (WMS).

Warehouse is continuing its importance in the modern supply chains. According to a survey conducted by European Logistics Association/AT Kearney, 2004 warehousing accounted for 24 percent of total logistics cost and according to the survey conducted by Establish Inc. /Herbert W. Davis & Co., 2005 in USA warehousing cost accounted to 22 percent of the total logistics cost. Warehousing has always been very significant in terms of cost, customer service and also plays an important role in the success or failure of many supply chains. (Baker, 2007)



### **3.13.1. Role of warehouse in supply chain**

Since inventory holding and the customer serving are key warehouse functions which implies warehouse has an important role to play in supply chain. Some of the important roles of warehouse are to make or break bulk.

Consolidation centres, cross docking centres, transshipment, product fulfilment centres, returned goods depots, some other roles like customer support, installation and repair services. The roles mentioned here are associated with some concepts like agility, production postponements and time compression which are recognized as increasing trends in warehousing. Thus inventory has important role on warehouse in modern supply chains. (Baker, 2007)

### **3.14. Labour management in warehousing**

An Ideal labour management measures the individual performances against standard times applied with the help of a labour management system that forms an interface between the labour management system and the time and attendance systems. The outcome results commonly in time, used by the warehouses to improve productivity. An effective labour management should support workload planning, process improvement, and in some cases, incentive schemes.

A basic challenge for all warehouse managers is allocating right number of people in the right place and at the right time to produce quality work. Warehouses with more number of employees result in high labour cost, low productivity and less profits. Alternatively with less staff there is a problem of employee burnout, quality problems and higher costs. It is a proven fact that labour management could cut down the costs to a considerable level arising due to labour, warehouses with a labour management can save more on increasing resources.

The growing demand for value-added services, labelling and promotional display, packaging, reverse logistics, recycled packaging and product for rework and customer returns, had a direct impact on the warehouse costs, and thereby increasing the cost per employee. Few case studies suggest an increase in productivity with labour management. Most of the warehouses have experienced a significant performance improvement, and also stated that performance would fall back considerable without a labour management application. (Dymond, 2007).

### **3.15. Inventory control**

Many concepts about control and management of inventory has been written but very little has been written about how inventory can be measured and monitored in a best way in the warehouse, even though the stock is measured and monitored every day by thousands of organizations. Inventory control has been represented as the function of management – forecasting, exploring requirements, setting up targets and issuing instructions. The monitoring of stocks in the warehouse is considered to be supervisory function, which requires less skill and experience. Overlooking of, monitoring and measurement process results in unreliable and low quality inventory management.

The main purpose of inventory management is to provide the appropriate information to improve operations and reduce errors, but very often it is confined to stock valuation process rather than contributing to effective logistics. The above statement is not to

contradict the theory part written about inventory control from many years, since it is a huge subject within the wider field of logistics and supply chain management, many of the texts provide important information on the control and stock monitoring and this theory part contributes a lot to the present inventory management systems for controlling and monitoring of stock. With a lot of improvement in the present information systems the feedback received is much faster thus provide a real-time control capability.

**Inventory in a warehouse:** Inventory in the warehouse can be categorised as follows:

- **Raw materials and components:** Goods purchased by the organization
- **Work in progress:** partly manufactured items and have had value added
- **Finished goods:** goods ready for shipment to customers

The quantity of goods held and their management will differ largely from one organization to another. In few organizations all the three goods were held in a warehouse at sometime, in some organizations the raw materials arrive when required and finished work in progress are held along a production line. It is very important that the inventory has to be monitored where ever it is held. (Ballard, 1996)

### **The role of inventories in SCM**

The concept of globalisation is resulting in longer supply lead times and according to the conventional inventory control theory greater inventory levels are to be maintained in order to provide the same customer service level. With longer gap supply lines with regard to distance there is always a possibility of great variation in the supply lead-time and this leads to the increase in safety stock. Significant cost economies can be achieved by despatching full container loads because of transport economy factor of long distance movements and this would tend to increase cycle stocks. (Baker, 2007)

In case of agile supply chains inventory is held in bulk and then the goods are passed via supply chain thus making the companies to act according to the market demands (Van Hoek et al., 2001)

## **3.16. Warehousing costs**

### **General overhead cost**

This cost involves the cost of the space available per cubic square foot and infrastructure. This also includes the cost for various security devices such as security alarms, auto IDs.

### **Delivery cost**

This cost includes the cost incurred in the distribution of the freight by an outside vendor. This cost includes the cost of fuel, insurance and the cost of the delivery trucks.

### **Labour cost**

This is the cost, which involves the cost of the labour that perform various operations in the warehouse including the operations such as receiving the incoming goods, entering the relevant data into the computer systems and some of the administrative duties such as assigning warehouse positions and job works on a daily basis.

The warehouse costs can also be classified as:

- Processing costs
- Storage costs ( Handling costs )

### **Processing costs**

These are the costs incurred by various operations and processes carried out in the warehouse such as receiving, storing, picking, packaging and shipping. If any other costs are involved in assembly are included in the processing cost.

### **Storage costs**

These are the costs incurred to store and handle the products and are also known as inventory holding costs. (Ezinearticles.com)

## **3.17. Total quality management in warehousing operations**

TQM is a management approach to the organizations which pay more emphasis on quality of the warehouse and the warehousing operations and it aims at long term success through customer satisfaction and some other benefits to the members of the organization and also to the society and the environment. TQM had a remarkable impact in the manufacturing industry as well as the logistics industry ever since it has been adopted by the businesses. The quality and the marvellous performance of a company mainly depends on four factors, those are: (Gunasekaran ,Marri, Menci, 1999).

### **3.17.1. Lean warehousing**

The generation of waste in the warehouses creates two problems:

- The value which is added is lost due to the wastes generated in the warehouse.
- The waste generates the cost of disposals which is always increasing in nature.

A strict inspection in the supply chain would prevent the wastes generated by transportation. In the manufacturing process if a defective item is produced, it merely ends up as a waste and thrown into the scrap which is disposed afterwards. To generate scrap as good as ordering things which will remain in the warehouse until they are disposed off. These also occupy lot of space in the warehouse which cannot be utilized for some other operations.

### **3.17.2. Total quality management**

TQM's main concept is to eliminate the waste and reduce the production of defective items during the manufacturing. The relationship between suppliers and buyers which ultimately leads to the final customer must be integrated to prevent poor quality.

Total quality control is the process of setting a standard of acceptability for the goods purchased in the warehousing operations. All the items need to comply with the specifications of the process or a product. If any item does not comply with the specification, it must immediately be rejected.

### 3.17.3. Continuous training period

Teamwork is always a great tool for the growth of any organization. Teamwork allows the sharing of skills and knowledge and helps to brainstorm new ideas among the departments and teams in a warehouse. Proper training is a good means to improve the skills and know how of warehouse personnel which in turn improves the overall standards of the warehouse. (Gunasekaran ,Marri, Menci, 1999)

### 3.17.4. ISO certification for a warehouse

The quality certification for a warehouse offers a proof of commitment to quality for a company which is certified with ISO certification. The certification also acts as a benchmark allowing the businesses to measure the progress towards the direction of continual improvement of the warehousing operations. If a company goes ahead for the certification, all the personnel should be aware of it and everybody should contribute for the achievement of the certification. The certification helps in growth of confidence within the company as well as the confidence of the client towards the supplier as a result of improved relations which become more visible and direct. There can also be accumulation of knowledge due to the quality standards followed in the company which helps the personnel to use that respective knowledge in the future. The efficiency as well as the control over the operations will also increase due to the growth of knowledge and confidence in an organization which is a direct impact of the certification. (Gunasekaran ,Marri, Menci, 1999).

## 3.18. Value adding activities in a warehouse

- Consolidation
- Product Mixing
- Service
- Contingency protection
- Smooth operation (Tompkins, smith, 1998) and (Jenkins 1968).

**Consolidation:** Warehouse unites these single items into a bulk order according to the manufacturers or plant requirements and then ships the unified product.

**Product mixing:** Normally a warehouse receives different kind of finished products from different plants, and one customer needs different mix of products which is effectively performed by warehouse.

**Service:** The service performed by the warehouse can be of different types starting from receiving until shipping of goods. For example some warehouse performs extra decorative things to the products before the final shipping to the customers.

**Contingency protection:** It is very important for the warehouses to maintain a back up data and other essential records in order to cope with any kind o situations. Normally, warehouse plans in advance for any future requirements such as inventory maintenance or storing of products or security of goods etc, thus always equipped with contingency protection.

**Smooth operation:** Warehouse between manufacturer and customer makes the operations very effective since different value adding activities are being performed at the warehouse. Consolidation and product mix are the two important activities which improve the customer satisfaction level and enable a smooth operation. Warehouse in position helps in shipping the right kind of goods to the right place at the right time.

### 3.19. Packaging

Packaging plays an important role in warehouse function since it has variety of advantages in different sections. Packaging plays an important role in enhancing the productivity and cutting the costs. Some of the important roles of packaging in warehouse are:

- Identifying the specific product and providing the information relating to the product.
- Improves the handling and distribution efficiency.
- Complete protection of the product.
- Customer interface.

**Consumer packaging:** It is concerned with the final display of the product to the customer i.e. related to marketing mix.

**Industrial Packaging:** It is mainly concerned with the protection of the product during handling process. Industrial packaging should enable efficient shipping characteristics, able to withstand stacking when placed on a pallet and overall protection of the product. (Wills 2007).

### 3.20. Computers in warehousing

In the earlier days, computer was used to provide detailed information of the inventory levels and the other transactions like orders and invoices to the management. This was only a passive use of the computer and all the information was again printed on reams and rolls of papers which were handed over to the operating managers in order to give the overview of the inventory status of the warehouse. Nowadays, computer has been transformed into much more effective and efficient tool for warehouse management.

All the warehouses use the computer as an operating tool which is integrated with the physical and control operations of the warehouse. The computer now acts almost like a human brain and it is always online and it can receive, retrieve and provide the necessary information and at the same time updates the records which help to control the warehouse operations efficiently. This can be accomplished in real time without any time lag for the updating the information. For instance, when an order is placed, the inventory can be allocated as soon as the order is placed, when the order is shipped out, the inventory can be reduced. When the goods are received and stored, the inventory is automatically updated and is available at that moment for new orders.

#### **Concept of a paperless warehouse**

The computer has eliminated tremendous amount of paper work transactions which take place on a daily basis in a warehouse. In between receiving and shipping there are many

operations which require lot of paper work. As the material is picked for an order, the operators must write down the quantity which is picked and all the other parameters which are necessary for giving the right information. The employee schedules and working hours also require lot of paper work which make it very hard to control and maintain all these records on mere paper sheets. This can be eliminated by integrating mechanical and electronic equipment by data scanning equipment which communicate directly with the computer, which in turn reduce the burden of paper work in the warehouse.

### **Control of computer in warehouse**

The mechanical and electrical equipment must be integrated in order to use them efficiently and effectively and this can be done perfectly by computer. This will in turn reduce the burden on the personnel and this can help in reduction of labour in warehouses.

The computer can be used for maintaining the identification and location of the goods in the warehouse. The computers can also be used to attain an optimized solution for using the floor space of the warehouse efficiently using some software which is installed in the computer.

The major advantages of computerization of the warehouses are:

- Improve productivity
- Control of physical operations
- Optimize the space utilization
- Maximize the flow of goods and increase the fill rate
- Minimize the costs
- Motivate the employees

The main fields in which computer are extensively used in a warehouse:

- Order entry
- Inventory management and control
- Receipts and inbound quality control
- Stock location and space utilization
- Work scheduling
- Quality control and assurance
- Integrating the computer with warehouse equipment
- Shipping schedules and transportation
- Employee satisfaction and motivation
- Warehouse performance reports (Raymond A. Nelson, 1985)

### **3.20.1. Integrating the computer with warehouse equipment**

Nowadays, all the mechanical and electrical equipment is more or less integrated with the computer systems in the warehouse. The equipment which is integrated to the computer system is:

- Moving materials
- Conveyors
- Forklift trucks
- Tractor trailer trains

- Drag lines
- Automatic guided vehicle systems

Storage material in the warehouse:

- Racks
- Shelving
- Automatic storage and retrieval systems

Picking customer orders:

- Pallet picking
- Case, inner pack, piece packing

Sorting and accumulation of material

- Sorting systems
- Conveyors
- Palletizers and De-palletizers

Controlling and recording activities in a warehouse

- Optical printing
- CRT devices
- Weigh scales
- Labelling systems
- Metering systems (Raymond A. Nelson, 1985)

### **3.20.2. The Ideal warehouse**

In the present business world, all the warehouses are striving to attain an ideal warehouse in which every equipment is automated and integrated with the computer systems which minimize the effort put on to perform the operation and cuts down the cost for the operation. This will at the same time reduce the man power required to perform various operations in a warehouse.

In a highly automated warehouse, material is received in unit loads or in cases on a case conveyor or a pallet, then these are made into unit loads and sent to automated storage and retrieval system. The unit loads can be picked easily from the automated storage and retrieval systems to fill the customer orders. They can also replenish case, inner packs etc. Then the material is picked and transferred through a conveyor to fulfil the customer order. The major problems in this kind of warehouse are that there is non-standardization for the pallet size, case, and the inner pack and not all goods have the same shape and size even among the same company products. This ideal warehouse system can be useful only when there is standardization of the pallets or the inner packs for the materials. (Raymond A. Nelson, 1985)

### **3.20.3. Shipping schedules and transportation arrangements**

The warehouse has two major functions which are:

- The transportation arrangements for delivering the goods from the warehouse to the customer. This means that there should be control on the warehouse owned, contract or the private carriers.

- The physical arrangements for shipping the material from the warehouse and the computer controls which are necessary for proper shipment accumulation and transfer of the shipment to the delivery vehicle.

The transportation arrangements are responsible for the scheduling of order picking in the warehouse. This is true for the pooling of small shipments to get a better freight rate. (Raymond A. Nelson, 1985)

One of the important concepts in transportation arrangement is pooling.

#### **3.20.4. Pooling**

It is a process in which small orders are consolidated to make one large shipment to take the advantage of reduced freight transportation charges for one large shipment, rather than delivering number of small shipments. In this way the transportation costs are cut down and there is a reduction of overall costs for the warehouse.

#### **3.20.5. Warehouse performance reports**

The warehouse performance reports are necessary to know where the warehouse stands in the business and it is the key performance indicator which tells how efficiently and effectively the warehouse is functioning. These performance reports should be developed on a timely basis.

There are basically two types of performance reports which are:

- Service performance reports
  - Order on time service report
  - Fill rate or completeness of order report
  - Accuracy of the orders filled
- Cost performance reports
  - Productivity of the personnel by warehouse function
  - Space utilization
  - Budget for the warehouse
  - Allocation of costs to all the operations

The reports should be generated on a regular basis to keep on tracking the performance of different operations and to have a continual improvement in the warehouse. These performance reports can be easily attained by the computer systems by giving certain commands through which the managers can find out the status of the warehouse performance.

In this way computers play a very important role in a warehouse and slowly but steadily all the businesses are heading towards 'The Ideal Warehouse' concept with the help of the latest technological developments in the field of computers and advanced equipment. (Raymond A. Nelson, 1985)



### **3.20.6. Voice directed picking**

This technology is slowly growing in the field of logistics. The operation mostly order picking is performed by the order picker with the help of this voice picking technology. The picker should wear a device having a headset and microphone and the picker is instructed by voice on what items to pick and where to pick them and they must confirm their actions by verbally back to the system. The device wore by the picker communicates with the warehouse management system (WMS) routed through a radio frequency or local area network (LAN). (Wikipedia).

The benefits attained by deploying the Voice direct picking technology are:

- Increased accuracy – 99.9% approximately
- Increased productivity – 15% approximately
- Removes the trips back to assignment desk
- Removes cost of printing and distributing the picking documents
- Removes cost of picking confirmations and re-entering order amendments
- Hands free and eyes free, less fatigue
- Real time feedback for proactive management
- Real time updation of stock
- Improved safety due to hands free and eyes free technology
- Reduced training because the verbal prompts are easier to perform
- Can be used in freezers and low temperature warehouses

## **4. EMPIRICAL STUDY**

The empirical study gives an insight of the present situation of the cases which include their operations, strategies in various aspects such as introduction of the company, general aspects in the company, data entry and communication, storage methods, operations, inventory management, handling and security, other activities and problem areas of the company.

### **4.1. Introduction to the company ÖoB**

Överskottsbolaget AB is one of the Sweden's leading companies in low price market segment. The group operates 85 retail stores all over Sweden and has a total of 1500 employees.

Runsvengruppen AB was founded in 1947 and has been importing goods from 1957 starting the first trade trip to China. ÖoB has nearly 15000 articles in each warehouse which are spread all over Sweden with easy accessibility to the retail stores. Överskottsbolaget is managed by a firm called Runsvengruppen AB.

Överskottsbolaget AB stores mainly sell goods within the following product segments:

- Leisure goods
- Home and interior furnishings
- Tools and equipment
- Household and grocery products
- Textiles and clothing
- Electrical appliances

### **History**

Runsvengruppen AB started in 1947 when 24 year old Rune Svensson decided to acquire his own village shop in Mariedamm in northern Östergötland. Large quantities were purchased direct from the factories and they were sold via mail orders. First departmental store was opened to keep up the demand in Linköping in 1961.

The existing warehouse premises were no longer adequate to store the inventory, Rune Svensson acquired a large property in Skänninge in 1957. Then it was relocated the following year. The business expanded gradually and a new plant was established for own manufacturing and also extensive wholesale operations were being carried out.

The departmental store chains Storcks, Storckens and Engelbrektsbodarna were acquired by the Runsvengruppen AB eventually. The most important milestone in the Runsvengruppen AB history is to acquire Överskottsbolaget AB in 1992 with nine of its departmental stores. The company opened new departmental stores in various locations in order to meet the demand of the customers. From the original 9 retail stores the number went up to 80 with the goal set to 100 stores. The warehouse locations and head office is shown in fig 4.1.

## Logistics

The present central warehouse is located in Skänninge with access to the head office with approximately 50000 square meters floor space. There are about 19200 box pallets which are dispatched from the main warehouse every month to different locations. The logistics function is a very decisive link in the product supply to their stores.

## Purchasing

An excellent product at low prices is the trademark of the company. This is only possible by the purchasing function used by the company. The purchases are handled by Runsvén AB which imports products directly from Europe, South America and also from Asia mainly China. Runsvén AB also has an office in Shanghai which allows the company to maintain good relations with the suppliers and ensure efficient and effective supply of goods.

## Wholesale operations

The company's wholesale operations exist right from the time when the company was established. The potential customers and clients are primarily independent businesses such as low priced markets that are not affiliated to any larger corporate chains. The range of products offered is very extensive and is around 3000 items. The products are directly distributed to the retail stores from the central warehouse in Skänninge. (Överskottsbolaget.se)

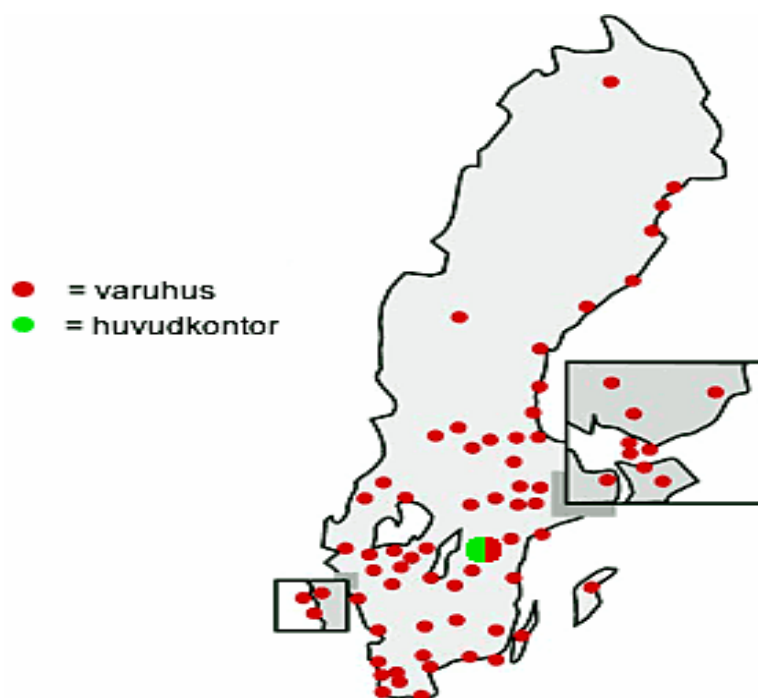


Figure 4.1 The location of warehouses and head office of ÖoB in Sweden (Source: Överskottsbolaget.se )

## **4.2. Case: ÖoB, Knalleland, Borås**

### **General information**

ÖoB, Borås was established in November, 2003 and there are 15 employees working in this particular branch. The employees are given training in handling and other shop floor requirements for 3 days before starting the actual work. The branch is certified with ISO 9001 standard certification. There are about 10 to 15 suppliers who cater the requirements of the company in the form of finished goods. The number of customers visiting the stores on a pay day is 1200 to 1800; there are about 800 to 1000 customers on a week day and 600 to 800 customers on the weekends. The warehouse floor space is 2100 square meters.

### **Storage and operations**

The goods are shipped using pallets, and these are then stored on the racks and aisles are also provided for easy access of the goods. The pallets used are standard EU pallets with the dimensions 800mm X 1200mm. ÖoB sells goods ranging from lighting gadgets, fitting accessories, paints and hardware, consumption material (Groceries), textiles, pet animals, household machines, food and accessories, kitchen accessories, mopeds, training tools etc. There are about 400 SKUs on the whole in the store. The on hand inventory is worth of about 7 million SEK.

The goods received are identified manually using the barcodes. The warehouse is equipped with 2 counter balanced trucks, one manual drive fork lift and 8 ordinary lifts.

The goods are shipped once in a day in order to replenish the goods in the inventory. During the peak demand periods and seasonal demands, the frequency of shipping is increased to 2 to 3 times a day according to the demand.

The packaging material used for the shipped goods is the corrugated cardboard boxes and any sort of value adding activity is not carried out in the warehouse. There is also no scope for any customized packing for specific customers.

### **Handling and security of the goods**

The damage occurs in house very rarely. The goods are handled very carefully and the personnel are given special training to handle the goods carefully. If any damage occurs due to the mis-handling by the warehouse employee, it is compensated by the employee himself and he takes the whole responsibility.

The warehouse is equipped with security alarms which ring whenever there is a security breach in the warehouse. One security personnel is also guarding the warehouse in order to prevent any theft. The whole block of the building is provided with a power generator which is located in the cellar of the building in case of any sudden power failure.

### **Data entry and communication**

The means of communication between the branches is internet and the telephone and there is no special approach like EDI in order to communicate between the warehouses.

The freight distribution is carried out by DHL and Schenker and sometimes ÖoB have their own vehicles in which the goods are distributed to this branch. If there is any damage while transportation, the logistics provider takes the whole responsibility and it is compensated by them.

The stock information is updated real time in the computer systems. Some times paperwork is also done in some cases. The company has got its own delivering company which distributes the goods to the respective branches and the communication is carried out using EDI.

The back up disk is run daily after the warehouse is closed ensuring there is a back up database for every transaction in the warehouse. The data retention period for the data is one year after which the data is erased.

The planning is done once in a week and usually it is done on Mondays. The warehouse uses a Warehouse management system called Enterprise system.

### **Problem areas**

The major problem area is the delayed delivery of goods and the whole schedule should be changed according to the time of the received goods. Although this problem is not so frequent, when it happens there is some chaos in the warehouse since the planning which is done prior to the delivery has to be changed due to the untimely delivery.

Some times the data entry is also a problem, since the computer systems do not respond to a particular command and due to this there are some delays in the data entry.

## **4.3. Introduction to the company Clas Ohlson**

Clas Ohlson started as a mail order company in 1918. The company founder, Clas Ohlson started the company by advertising the technical handbooks in Swedish magazine called Triumf. Clas Ohlson was gradually extending its services into technical products such as art materials, tools, boat, cameras, furniture designs and photographic equipment.

Clas Ohlson soon was producing designs and kits for both battery operated valve radios and crystal radios from early 1925. A store was opened in Insjön which dealt with the mail order trade which was the core operation until 1980s. Since then the space in the store has been expanded several times and at present every store has an area of 2000 square metres. The main store in Insjön is visited by over 600,000 customers every year. This store is also a training facility for new sales executives who undergo training for two weeks. The new Central warehouse was opened in 1995 and expanded in 1999 and 2004.

Clas Ohlson widened its operations in 1989 by opening a store in Central Stockholm. The store now has an area of about 2200 square metres. Since then numerous stores have been opened in almost all the regions in Sweden.

In 1985 Clas Ohlson started trading in Norway as well and at first the business was only mail order, and then in 1991 Norwegian first store was opened in Oslo. Since then few more stores have been opened in various locations in Norway. The first store was opened in Finland in November 2002 and from then few more was opened in Finland also. (Clasohlson.co.uk)

### **Clas Ohlson today**

Clas Ohlson has developed into a Nordic retail chain with 89 stores all over the Nordic region, the warehouses are shown in the figure 4.2. The turnover is about 4.7 Billion SEK with 3000 employees. Every year there are 46 million visitors and about 24 million customers. The product range is very broad with 15000 articles for home, hobby, electrical and multimedia. They purchase goods from over 30 countries, mostly from Asia and have nearly 800 suppliers.

### **Business concept and strategies**

The business concept of Clas Ohlson is to make it easy for the people to solve their little practical problems in everyday life. This business concept is based on the original saying of the founder Clas Ohlson: "We will sell dependable products at low prices and the right quality according to need." The main aim of Clas Ohlson is to provide high service level through helpful and knowledgeable staff who guides customers to simple solutions. The company also stipulates requirements for their suppliers with regard to working conditions, working environment, environmental impact and also the quality of the products.



Figure 4.2 warehouse locations Clas Ohlson in Nordic region (Source: clasohlson.se)

## **4.4. Case: Clas Ohlson, Knallerian, Knalleland**

### **General information**

Clas Ohlson retail warehouse which is located in Knalleland was established in 2002 in Borås. There are 20 employees working in this branch and the employees are given training for one day before performing the actual job work. The company has not got any quality certification such as ISO for the warehouse operations.

The number of customers during a day would be around 1000 to 1500. The available warehouse floor space is about 1500 square meters. The product range of Clas Ohlson is quite vast ranging from products such as home and storage, hobby, tools, electronics and media, fittings, optics, stationary goods etc.

### **Storage and operations**

The goods which are received from the central warehouse in Insjön are basically palletized for the convenience of the transportation and then unloaded and they are directly placed on the store shelves. There is no special warehouse space to stock the received goods. The major part of the warehousing operations is carried out in the central warehouse in Insjön, Dalarna, Sweden and the sorting is done there and then sent to the retail warehouses all over Sweden. The pallet used in the logistics of the goods is the standard EU pallet which is 800 mm X 1200 mm.

All the items carry the bar codes for the identification purposes and as soon as the goods are shipped to the respective branches, the goods are identified by their specific bar codes manually by the personnel and then they are placed directly on the shelves of the retail store and the storage time is eliminated in the warehouse. The bar codes are identified manually by the personnel using the barcode readers and there is no automation of the identification. The warehouse is equipped with two manual drive fork lifts which are operated by trained personnel.

The seasonal demand in the market is estimated and the inventory level is increased to a certain level depending upon the demand and there is more frequent shipping of goods from the centralized distribution centre. The number of employees is also increased during the festive seasons in order to tackle the increased number of customers and to increase the customer service level and satisfaction. The packaging material used to protect the goods is a kind of plastic material which is customized by the company. There are no value adding activities in the warehouse, since the goods which are shipped are directly placed on the retail store shelves.

### **Handling of goods and security**

The employees are given special training in handling the goods with care and ensure to follow right methods to handle the goods without damaging them. The frequency of damage of the goods is very low and any damage caused by the employees due to mis-handling is compensated by the company as per the company's policy.

The security of the goods is provided by the security alarm equipped in the premises of the store and there are readers at the exit of the store in order to prevent any possibility of theft by recognizing the security tags provided to each and every item in the store.

In case of any power failure, a generator is present which can be used as an alternative when there sudden power failure. There are also fire alarms and extinguishers in case any fire accident.

### **Data entry and communication**

There is not much communication between the branches of Clas Ohlson but the information is shared between the centralized distribution centre and the branches through telephone, internet and there is also a specific warehouse management system which is used for all the logistical purposes carried out in the company. All the transactions related to the suppliers are carried out only between the central warehouse and the suppliers. The individual branches do not have any kind of communication with the suppliers.

The distribution of goods from the central warehouse to the respective branches is performed by a third party i.e. Swedish postal service in this case. They are responsible for any kind of disturbance or damage of goods during the distribution of the goods to the branches.

The stock information is updated real time in the computers automatically as soon as the goods arrive at the warehouse and as soon as the goods are sold and taken away by the customer from the store. The backup disk is run very frequently in order to have a copy of the transactions and the whole database in case the existing disk crashes. The data retention period of this data is decided by the central warehouse and they look after the databases reducing the responsibility of the branches.

### **Problem areas**

The only problem in the warehouse is with the computerized data entry, sometimes the systems hang up and create some problem which is then taken care by the system analysts and then the whole process is again put into position.

## **4.5. Introduction to the company Stadium**

### **History**

The root of stadium goes back to the year 1974 when Ulf Eklöf one of the founders took over the Spiralen sport store situated in Norrköping. At this period of time Spiralen was an ordinary sports store covering 180 Square meters. In a short period of time Spiralen Sport developed into a sports department store and started focussing on large volumes and low prices. The first Stadium store is started in 1987 at Sergelgatan in Stockholm. Introduction of the new concepts such as product display solution and the store's entrance has revolutionised the entire sports industry.

### **Stadium today**

Stadium has about 109 stores in Sweden, Denmark and Finland. Stadium is considered to be the largest retail chain (privately owned) in Sweden, with an annual turnover of



4.3 MSEK inclusive of value added tax, and nearly 3000 employees. The Stadium chain is owned by brothers Ulf and Bo Eklöf.

The products range are products for an active life, clothes, shoes, kits, kickboards, inlines, skis, golfing equipments and equipment for team sports. Stadium comprises of all branded products as well as the Group's own brands, such as Warp, Everest, Soc and 4D.

### **Other business activities**

“Efficient processes for supply chain management and stock replenishment are crucial to us. Before we implemented IFS Applications we had to handle many of these processes manually, which wasn't viable for us because we wanted to be one of the leading players in the trade.” As said by Stefan Maxeby, Project Manager at Stadium.

#### **Key Benefits with IFS Applications**

- Clear visibility which ensures the right products to be delivered at the right time
- Optimization of supply chain management
- Reduced inventory levels
- Smoother purchasing transactions
- Centralization of financial processing
- Automated flow of goods
- Eliminating manual processes
- Time-saving for the stores
- Collaborating with IFS improved sales forecasting (IFSworld.com)

Stadium has implemented the following solutions

- IFS Distribution
- Retail and Wholesale Distribution
- Supply Chain Management Software.

### **Benefits in Stadium**

- Better visibility to ensure the right products are in the stores at the right time
- Optimized Supply Chain Management
- Lower inventory levels
- Smoother purchasing routines
- Centralized financial processes
- Automated goods flows
- No need for manual processes
- Time- saving for each store
- Collaboration with IFS to refine sales forecasting (Stadium.dk)

## **4.6. Case: Stadium, Knalleland, Borås**

### **General Information**

Stadium at Knalleland, Borås has been operating since 12 years and the present day work force for this warehouse is 11 employees and 11 reserve employees for weekends and other peak demand periods such as vacations or festive seasons. The employees are given training for about 1 week in receiving, handling and picking the goods before they perform actual job.

The total warehouse space is around 900 to 1000 square meters. The branch in Knalleland has been certified with ISO 9001 certification. The number of customer walk-ins per day in all the weekdays is around 500 and in weekends it is 1000. The product range of Stadium is sports goods and fashion clothes and mostly are branded items.

### **Storage and operations**

Palletizing and storing on aisles and small racks are the storage methods used in Borås branch, and the standard EU pallet (800mmx1200mm) is used for the handling and transportation purposes. All the items carry the bar codes for the identification purposes and as soon as the goods are shipped will be identified by their specific bar codes manually by the personnel and then they are placed directly on the shelves of the retail store and the storage time is eliminated in the warehouse. The bar codes are identified manually by the personnel using the barcode readers and there is no automation of the identification.

The warehouse is equipped with one manual drive fork lift for handling purposes i.e. loading and unloading. The total overall inventory level is around 55000 articles in the store. For different festive seasons extra staff and extra inventory is maintained, for e.g. Normally 9 to 11 employees work in day and for the festive season 12 to 13 employees will be working and there is also an extra level of inventory which is maintained in order to cope up with the demand and the increased number of customers during peak demand.

Corrugated cardboard boxes are the packaging material used in this particular warehouse for protection of goods and there is no value adding activity performed at the warehouse since the goods shipped to this branch are ready to display at the retail store for the end customer. There is no specific/customized packaging method for specific customers.

### **Handling goods and security**

The frequency of damage to the goods is very less in the warehouse. The goods are handled very carefully and the personnel are given special training to handle the goods carefully. In case of the damage in the warehouse, the cost is compensated by the company according to the company's policy.

The goods in the warehouse are secured by means of security alarms and also one security personnel available to look after the warehouse. This particular branch has no contingency plan for the power failure i.e. they don't have any power generator in case of power failure. Fire alarms and fire extinguishers are present in case of any fire accidents.

## **Data entry and communication**

There is an inter-communication between the branches, and the communication is carried out with the help of Internet, telephone and meetings. No special approach is operated by central warehouse for the communication between all the warehouses. The logistics and distribution is outsourced to Swedish Postal Service since Stadium believe that it is the forwarder with largest network and have more resources than any other company in Sweden.

The stock information is updated for every two hours and the updating process is computerized. The same updating is carried out in central warehouse at Norrköping since all the branches are intercommunicated, thus providing information to the central warehouse of any out of stock issues. Backup data is available at the head office of Stadium which is located in Norrköping. There is also communication between the suppliers and the central warehouse at Norrköping. The main server is located at Norrköping and all the backup data is fed into the main server. Planning horizon is normally 2 days. Stadium at Knalleland is using a WMS based on the Citrix environment.

## **Problem areas**

The biggest problem is the Manpower management and it is very difficult to adjust the well trained staff when somebody is sick. They don't have any problems with the computer systems.

## **4.7. Introduction to the company Åhlens**

Åhlens is a part of AXEL JOHNSON AB group, Axel Johnson International, Mekonomen, Axfood, Novax, Servera, Svensk Bevaknings Tansy are also part of the same group. Axel Johnson started his first trading business A. Johnson & Co, on Lilla Nygatan Stockholm in the year 1873.

In 1958, the company was divided into two A. Johnson & Co and Nordstjernan AB, both managed by Axel Axson Johnson. A. Johnson & Co expanded into an international trading company responsible for marketing its own brand through the world and conducts its own trading operations in raw materials and industrial products. In 1970's, J S Saba was established in the United States and the company now called Axel Johnson Inc. The acquisition of the Saba group in 1988 made names Phlmes, Dagab, and Hemköp of the Axel Johnson AB group.

Åhlens was established in 1899 as the mail order business by the name Åhlen & Holm and operation were carried out from a small city called Insjön in Dalarna. In 1915 the headquarters was shifted to Stockholm as the business started booming. (Åhlens.se)

In the 1930s the mail order business concept has been changed to department stores, and the company opened its first departmental store in 1932 at Östermalmstorg in Stockholm. In 1964 Åhlens city, Sweden's largest departmental store, was opened in the center of

Stockholm. In 1976 the Tempo Chain joined with EPA, and in 1985 all the department stores were re-profiled as Åhléns. Since 1988, Åhléns has been a wholly owned subsidiary of Axel Johnson PLC.

### **Åhlens today**

Today Åhlens is the completely owned subsidiary of Axel Johnson AB, which in turn is controlled and owned by Antonia Axelson Johnson, one of the richest women in Sweden and one of the country's leading capitalists.

Åhlens is a Swedish chain of departmental stores, located in almost every main city in the country and in Stockholm alone 18 stores are available and a total of 72 stores in 60 towns are operating. Åhlens is considered to be the best chain for modern shopping for the eternally young customers. Åhlens is a leading retailer in various fields and is one of the most well known brands in Sweden. Operations of Åhlens are focused on five business areas: Mode (Fashion), Skönhet (Beauty), Hem (Homeware) , Media and club/Internet - in which customers will find Fashion Clothing, Home Furnishings, Books, CDs, Multimedia, Toys, Cosmetics and Beauty products. Within these five business areas wide variety of trendy and stylish products are offered by Åhlens.

A unique transformation has been started in 1990s which made Åhlens to transform itself into a modern retail chain of high international standard. In this process all the department stores nation wide are being modernized to become attractive department stores of the future.

## **4.8. Case: Åhlens AB, Lilla Brogatan 8, Borås**

### **General information:**

Åhlens warehouse is situated at Lilla Brogatan 8, Borås and has a total of 11 employees working and there is no special training given to the employees for handling of goods within the warehouse.

Åhlens retail store sell its own brand item and suppliers from Asia forms the major part. In normal day there are around 800 to 900 customers walkins to the store. The total warehouse space is 2000 square meters. The product range of Åhlens is mainly family clothing, furniture, interior decoration material, perfumes and other merchandise. Åhlens also has different kind of single items and thus the overall SKUs range some where between 1500 to 2000.

### **Storage and operations**

No special methods for storage are performed in the warehouse since as soon as the goods enter the facility they are placed on the respective allocated areas in the retail store. Plastic boxes which are specially made for the company are used for handling purpose.

All the items carry the bar codes for the identification purposes and as soon as the

goods are shipped to the respective branches; the goods are identified by their specific bar codes manually by the personnel and then they are placed directly on the shelves of the retail store and the storage time is eliminated in the warehouse. The bar codes are identified manually by the personnel using the barcode readers and there is no automation of the identification.

Åhlens warehouse is equipped with 5 manual fork lifts and 1 motorised drive forklift for handling purpose i.e. loading and unloading. The total inventory level is around 15000 to 20000 articles. An increased level of inventory is maintained in the warehouse during seasonal demand and also extra staff is recruited according to the seasonal demand.

Plastic materials are the packaging materials used in this particular warehouse for the protection of goods, and there is no value adding activity performed at the warehouse since the goods are shipped to this branch and are ready to display at the retail store for the end customer. There is no specific/customized packaging method for specific customers. It is maintaining an inventory worth around 5 million SEK.

### **Handling and security**

The damage occurs in warehouse very rarely and employees take whole responsibility of handling the goods. The goods in the retail warehouse are mostly fragile goods, employees take extra care in handling process. Employees bear the cost if any damage occurs to the goods within the warehouse and compensates for the damage and if it occurs outside the warehouse the freight distributor takes the responsibility and he compensates for the damage. Normally a security alarm is used for the security of goods and in festive season's one security personnel is appointed. Battery power is another alternative in case of power failure.

### **Data entry and communication**

There is an inter-communication between the branches, and the communication is carried out with the help of Internet, telephone or by fax. All the transactions are carried out by the head office in Stockholm. The logistics and distribution is outsourced to DHL. The stock information is updated real time automatically and that is reflected in all the branches including the central distribution center in Stockholm. All the stores in Sweden are linked to Intercontinental group of department stores and they use the same Warehouse management system. The data is stored in the main server at central distribution center in Stockholm and the planning horizon is done by head office in Stockholm.

### **Problem areas**

Very negligible daily problems which are easily solved but an opportunity is there to use the space of the packing material i.e. plastic boxes which come from Stockholm because sometimes they are partly filled and sent wasting the space inside the box.

There is sometimes problem with the man power management when somebody is sick and there is no alternative for him.

## 5. ANALYSIS

This chapter analyses the present case study subjects by performing a cross case analysis on the four company's warehouses. This analysis is performed by combining the theoretical as well as the empirical findings which are carried out in the previous chapters.

### 5.1. Cross Case Analysis

#### 5.1.1. General aspects of the warehouses

Table 5.1 General aspects

General	ÖoB	Clas Ohlson	Stadium	Åhlens
Number of employees	15	20	11 + 11 Reserve	11
Training period in days	3	1	7	No
Period of establishment in years	5	6	12	Not available
Total number of warehouses	85	100	109	80
Standards certification	ISO 9001	No	ISO 9001	Not available
Number of suppliers	10 to 15	800	Not available	Not available
Number of customers (Average per day)	800	1250	650	850
Warehouse floor space (Square meters)	2100	1500	1000	2000

#### Number of employees

The results of the empirical study show that, the number of employees in ÖoB, Clas Ohlson, Stadium, Åhlens is 15, 20, 11 and 11 respectively. We can clearly observe that the number of employees in Clas Ohlson is higher than the other warehouses. In case of Clas Ohlson, there are 20 employees which is quite high when compared to the other stores but due to the variety, range of the goods, high number of SKUs there is a requirement for greater number of employees to manage the warehouse effectively. The other two warehouses i.e. ÖoB and Åhlens employ 15 and 11 personnel to take care of the warehouse operations which are moderate when compared to Clas Ohlson.

In case of Stadium, they apply a very good strategy in order to maintain optimum number of employees. They have normally 11 employees and remaining 11 reserve employees are used during festive seasons and during the period of peak demands. These 11 employees are handy when somebody is sick or on vacation as well. They plan the man power as and when there is a peak demand such as festive season and during seasonal discount sales and during the remaining time they perform their operations only with 11 employees. This strategy helps them to reduce the labour cost and if the work load is more during the period of peak demands, then the reserve employees come into the picture.

## **Training period**

As far as the training period of the employees is concerned in our cases, all the companies offer an initial training period except Åhlens. This company does not give any special training as such, instead the employees are given suggestions as and when they are needed on the spot while they are performing a particular task. The only training given is the training involved in driving the forklift, since it is very important to handle the goods with utmost care and insufficient knowledge can lead to accidents and damages in the warehouse. The forklift drivers must also possess a driving license of driving tractors and forklifts without which a person cannot drive a forklift. The training period offered by Stadium is one week which is far more than the other two cases i.e. 3 days for ÖoB and 1 day for Clas Ohlson before the actual job is performed by the employee.

## **Warehouse floor space**

The warehouse floor space is comparatively similar for all the warehouses except Stadium where the space is only 1000 square meters. ÖoB has a warehouse floor space of 2100 square meters which is higher than the other warehouses. This is understandable since ÖoB has a very wide product range and numbers of SKUs are also quite high. Due to this, they need bigger warehouse space to operate well with good efficiency. In the case of Stadium the floor space is 1000 square meters but the products are not bulky as in the case of ÖoB and Åhlens. In this way Stadium is saving the cost incurred by having bigger warehouse space. As the warehouse floor space increases, the rental incurred for hiring the infrastructure also increases which in turn increases the overall warehousing costs.

## **Number of customers**

The average number of customers during a day in all the retail stores is similar except Class Ohlson, they have higher number of customer walk-ins in a day i.e. 1250 customers on an average in a day. If we compare the customer service level for all the retail warehouses, it is observed that ÖoB has good customer service level than the other stores since the ratio of the customers visiting in a day to the number of employees is low in the case of ÖoB and in the case of Åhlens the ratio is high which means that the one employee can handle about 77 customers in a day which is quite high and there is a chance that the customer is offended easily due to the long waiting times and queues for the representatives to attend the customers. In the case of Clas Ohlson and Stadium the ratio is almost similar and we can say that the customer service level is intermittent when compared to ÖoB and Åhlens which are two extremes in the comparison.

## **Number of suppliers**

The number of suppliers for ÖoB is about 15 which is comparatively far less than the number of suppliers for Clas Ohlson i.e. 800. The communication and transaction between the suppliers and the retailers is very difficult and cumbersome in the case Clas Ohlson because it should handle 800 suppliers at a time to send and receive information, ordering the quantities of the products and performing transactions such as receiving and invoicing etc. Whereas in the case of ÖoB it is not that difficult since the number of suppliers is only 15.

## Number of warehouses

The number of warehouses are ranging from 80 to 109 for the case companies which are high number and it implies that all the four companies are well established in their respective fields. Some of the companies such as Clas Ohlson and Stadium are expanding their departmental stores to the neighbouring countries to Sweden such as Norway, Finland and Denmark. It is a very difficult task for the central warehouses to manage the communication as well as the logistics between all the departmental stores which are spread all over Sweden. Most of the companies prefer to outsource the distribution process to third party logisticians like Swedish Postal Service, DHL and Schenker. In this way they can emphasize more on their core operations which are performed within the warehouses.

## ISO certification

ÖoB and Stadium are certified with ISO 9001:2000 and this quality certification obviously helps in growth of confidence for the companies since the customers are always looking for high standards of the items and compliance to the specifications. Most of the customers look for quality certification when they are purchasing any product so it is very important to have an ISO certification for the operations in order to gain the confidence of the customers, this is as stated by the warehouse managers of both ÖoB and Stadium. On the contrary, in the case of Clas Ohlson there is no certification of any kind for the warehouse operations but still the number of customers visiting the retail store in a day is far high than the other stores.

### 5.1.2. Storage

Table 5.2 Storage

Storage	ÖoB	Clas Ohlson	Stadium	Åhlens
Storage method	Rack and aisle method	Directly placed on the store shelves after receiving	Rack and aisle method	Directly placed on the store shelves after receiving
Pallet size	EU Pallet	EU Pallet	EU Pallet	Customized plastic box
Type of products	Groceries, accessories, hardware, tools	Home and storage, electronics, media, fitting, optics	Sports material, fashion clothes	Family clothing, furniture, interiors, perfumes
Number of SKUs	400	N/A	N/A	1500 to 2000

### Storage methods

Considering the cases of ÖoB and Stadium, both are using traditional racks and aisles for storage and this arrangement has its own advantages and disadvantages, when compared



to other two cases. The racks and aisles do not come into picture in the case of Clas Ohlson and Åhlens, since these companies directly place the goods which are received on to the shelves of the retail store, thus completely eliminating the warehouse concept, since all the warehousing operations like sorting, packaging etc are done at their respective central warehouses.

In the case of ÖoB and Stadium, the warehouses should bear the warehouse costs generated by the functioning of the warehouse. On the contrary, Clas Ohlson and Åhlens are adopting a strategy to completely eliminate the concept of warehousing; they are placing the received goods directly into the shelves of the retail store which cuts down the cost of having a warehouse. All the warehousing operations such as sorting, packaging etc. are carried out in their respective centralised warehouses and the goods which are ready to store are then shipped to their respective individual departmental stores all over Sweden. This strategy is very much advantageous for Clas Ohlson and Åhlens over ÖoB and Stadium which have a warehouse for every departmental store.

### **Palletizing**

In case of ÖoB, Clas Ohlson and Stadium, standard EU pallets are being used whereas Åhlens is using customized plastic boxes which are exclusively designed and manufactured for them and used for their warehousing purposes. An EU pallet has some advantages over plastic boxes since most of the present logistics operations and storage systems consider the EU pallets as the standard pallet size. The loading and unloading methods are made easier, since all the handling methods and handling vehicles such as forklifts and counter balanced trucks are adaptable to EU pallets. Whereas in the case of Åhlens the plastic boxes need special handling methods and vehicles, thus adding to the warehouse cost. According to the warehouse manager of Åhlens (Borås), the goods in the warehouse are very fragile and delicate such as glassware, ceramics which are the basic products of Åhlens and which can get damaged easily due to mishandling, so they need special kind of plastic boxes to handle them carefully and to give them extra protection.

### **Product range**

All the four stores have a great variety of products and the product range is quite high and the products sold are not similar to any other company. Each store has their own business area and has varied type of products, reducing the competition with each other. The products sold by of ÖoB are related to groceries, hardware and tools. Clas Ohlson mainly sells electronic goods, home appliances, media and other. Stadium sells sports material and fashion clothes related to sports and Åhlens sells family clothing, interiors, perfumes and furniture.

### **SKUs**

The number of SKUs in ÖoB is about 400 which is reasonable for such a big warehouse. Åhlens has 1500 to 2000 different SKUs which is far higher than ÖoB which means that the inventory management is very critical in the case of Åhlens when compared to ÖoB. The number of SKUs is very crucial factor for any business since the inventory management is very much dependent on the number of SKUs. As the number of SKUs increase in a warehouse, inventory becomes very hard to manage since the personnel has

to track and pick the right product without any error and tracking is not so easy when there are 20000 articles which have 1500 to 2000 SKUs in it. The data is not available for the other two companies since it is against their company's policy to give out the information and statistics about the inventory.

### 5.1.3. Operations

Table 5.3 Warehouse Operations

Operations	ÖoB	Clas Ohlson	Stadium	Åhlens
Identification of goods	Barcodes manually	Barcodes manually	Barcodes manually	Barcodes manually
Data entry	Computerized	Computerized	Computerized	Computerized
Loading and unloading equipment	Counter balanced truck -2, Forklift - 1, Manual lift - 8	Manual lift - 2	Manual lift- 1	Fork lift - 1, Manual lift - 5

#### Identification of goods

All the warehouses in our case are using the barcode technology to identify the goods and the identification is done manually by sensing the barcode with the help of a barcode reader. This is the most common method used in the warehouses nowadays. The present warehouses are not really indulging into deploying latest technologies like RFID and other auto identification processes due to the high initial investment costs and the businesses have a fear of not getting the payback in the near future after installing Auto-ID or RFID technologies.

Most of the warehouses are adapting to a mixture of both conventional as well as the new technologies in order to limit the overall cost for installation of the technology. Although, new technologies enable the warehouses to automatically identify the goods when they are received, the present four warehouses are still using the conventional barcode system by identifying the goods manually by hand.

#### Data entry

All the warehouses in the case study are computerized warehouses and the data is fed into the computer systems and there is very less paperwork in the system in order to decrease the time taken for entering the data and maintaining the transactions taking place in the warehouses like invoicing, receiving documents etc.

#### Loading and unloading equipment

The number of mechanical equipment in ÖoB is far higher than its counterparts since the floor space is higher than the other warehouses i.e. 2100 square meters. They have two counter balanced trucks, one forklift and eight manual lifters to perform loading and unloading of the goods. This is very obvious because the product range of ÖoB is

very wide and they have many heavy and big sized products which cannot be handled manually and because of this reason, they are forced to use the mechanical equipment such as counter balanced trucks and forklifts.

On the contrary, one of its counterparts Stadium although having a warehouse which is comparatively reasonable in size has only one manual lift since they deal with shoes, sports clothing and sports material which are not so bulky. They are not using any sophisticated mechanical equipment such as counter balanced trucks, forklifts etc.

In the case of retail warehouses of Clas Ohlson and Åhlens, they have very few forklifts i.e. one forklift in Åhlens and rest are manual lifters. This situation can be understood since the goods received are not stored in the warehouse, instead they are directly placed on the shelves of the retail stores. The goods inflow to the stores is not bulky because the shipments sent from the central warehouses are in small quantities according to the demand. This implies that the goods are received in small packages which can easily handled manually or by the manual lifters which are sufficient to handle the goods.

#### 5.1.4. Handling and security of the goods

Table 5.4 Handling and security

<b>Handling and security</b>	<b>ÖoB</b>	<b>Clas Ohlson</b>	<b>Stadium</b>	<b>Åhlens</b>
Frequency of occurrence of damage	Very low	Very low	Very low	Very low
Damage compensation	Employee responsibility	Company responsibility	Company responsibility	Employee responsibility
Security of goods	1 security personnel, security alarms	only security alarms	1 security personnel, security alarms	Security alarms and security personnel for festive season
Contingency plan for power failure	Generator available	Generator available	No plan	Battery power available
Fire safety	Fire alarms and extinguishers	Fire alarms and extinguishers	Fire alarms and extinguishers	Fire alarms and extinguishers

#### Frequency of damage occurrence

In all the cases, the frequency of damage is very less as mentioned by their respective warehouse managers. The damage compensation is compensated by the employee himself in the case of ÖoB and Åhlens and compensated by company in the case of Clas Ohlson and Stadium, thus the damage compensation bore by the company cases add to the warehouse cost. In the present cases, since the damage occurrence within the warehouses is very less, it does not have much effect on the warehouse cost. In case of Åhlens, no special training is given to the employees and moreover they have to handle fragile goods. Due to these reasons the employees have extra pressure and work load in handling the goods.

## Security of goods

In case of ÖoB, Stadium and Åhlens, there have security personnel as well as security alarms installed for the security of goods except Clas Ohlson where only security alarms are used. An extra security personnel adds to the labour cost for the companies but at the same time the security of the goods is equally important for the companies. According to the warehouse managers of ÖoB, Stadium and Åhlens, they want to provide extra security for the goods even though if it adds to the warehouse cost.

## Contingency plan for power failure

ÖoB and Clas Ohlson have a power generator in case of power failure whereas Åhlens has a backup battery for the same purpose. In the case of Stadium there is no contingency plan for the power failure which can affect warehouse operations to a great extent in case of sudden power failure. There should always be a contingency plan for power failure should be available, since all the operations will be stopped whenever there is a power failure. Even though in countries like Sweden power loss is very rare thing to happen, there should always be a contingency or backup plan.

## Fire safety

According to the rules and regulations in Sweden, all the warehouses should comply with specific standards of fire safety, thus forcing the companies for the compulsive installation of fire alarms and extinguishers.

All warehouses in the present case are equipped with fire alarms and extinguishers according to the required standards of fire protection service.

## 5.1.5. Other activities

Table 5.5 Other activities

Other activities	ÖoB	Clas Ohlson	Stadium	Åhlens
Packaging material	Corrugated cardboard boxes	Plastic boxes	Corrugated cardboard boxes	Plastic boxes
Customized packaging	No	No	No	No
Value adding activities	No	No	No	No

## Packaging material

In the present study, ÖoB and Stadium are using corrugated card board boxes as packaging material. On the other hand, Clas Ohlson and Åhlens are using plastic boxes as packaging materials. Since the product type handled by ÖoB and Stadium are

groceries and sporting material respectively which are not much fragile in nature, they prefer corrugated card board boxes, and the products handled by Clas Ohlson and Åhlens are fragile and delicate in nature such as glass ware, ceramics, electronic goods, hence they prefer plastic containers for extra protection even though the cost is more.

Customized packaging and value adding activity needs skillful labour and extra resources to perform, thus adding to the total warehouse costs. In the present case none of the warehouses perform any customized packaging operations or value adding activity, since these are done at the respective headoffice.

### 5.1.6. Inventory management

Table 5.6 Inventory management

<b>Inventory</b>	<b>ÖoB</b>	<b>Clas Ohlson</b>	<b>Stadium</b>	<b>Åhlens</b>
Total inventory level( Number of items )	N/A	N/A	55000	20000
Value of hand on inventory in SEK	7 million	N/A	N/A	5 million
Inventory for seasonal demand	Normally 1 load, Seasonal 3 loads a day	Increase of inventory	Increase in inventory and staff (12 persons a day, Normally 9 persons a day)	Increased staff and inventory

### Inventory

In the present case, we don't have much information about number of articles in ÖoB and Clas Ohlson. Stadium and Åhlens have 55000 and 20000 articles as inventory respectively. In case of Åhlens, the number of articles to be monitored is less compared to Stadium with respect to equal number of employees, which means that Åhlens has scope for good inventory management when compared to stadium due to less number of articles. This also results in effective information sharing within Åhlens and assisting the warehouse operations in a great deal and reducing the errors.

Considering warehouse space as the comparison factor, Åhlens has 2000 square meters and Stadium has 1000 square meters of floor space, so the number articles to warehouse space in Åhlens is less compared to Stadium that means the monitoring of stocks is easier in case of Åhlens than Stadium, which results in good quality inventory management. Åhlens has the advantage of good inventory control at the cost of low warehouse space utilization, which means that the warehouse floor space is not being utilized well in case of Åhlens.

## Value of on-hand inventory

The value of on-hand inventory for ÖoB is 7 million SEK whereas in Åhlens is 5 million SEK. The data is not available for Clas Ohlson and Stadium because giving the inventory information is considered to be against policies of many companies due to the evolving competition in the market.

## Inventory management during seasonal demand

All the warehouses manage the inventory during seasonal demand by increasing the number of personnel in a shift and also by increasing the inflow of goods to the inventory from the central warehouses. This is the most common practice for the companies to handle the seasonal demand in an effective way.

### 5.1.7. Data entry and communication

Table 5.7 Data entry and communication

Data entry and communication	ÖoB	Clas Ohlson	Stadium	Åhlens
Intercommunication between various branches	Yes	Very less	Yes	Yes
Communication with the centralized warehouse	Internet, telephone, fax	Internet, telephone	Internet, telephone, meetings	IGDS group WMS
Stock updation	Real time, Computerized	Real time, Computerized	Every 2 hours	Real time, automated
Method of communication with suppliers	Paperwork, EDI within ÖoB	Between central warehouse in Dalarna	Paperwork and internet	Intercontinental group of departmental stores WMS
Backup data	Available and run daily	Available and run frequently	Available in server in Norrköping(Central warehouse)	Available in server in Stockholm(Central warehouse)
Data retention period	1 year	N/A	N/A	N/A
Planning horizon	7 days	Done by central warehouse	2 days	Done by central warehouse
Deployment of WMS	Enterprise system	N/A	WMS with Citrix environment	IGDS group WMS
Outsourcing logistical operations	DHL, Schenker, ÖoBs own freight company	Swedish postal service	Swedish postal service	DHL

### Intercommunication with various branches

In case of ÖoB, Stadium and Åhlens there exists a very good intercommunication between the various branches, whereas in case of Clas Ohlson the intercommunication

between branches is very less. In the other 3 cases pooling is done very easily if it is necessary, since if any warehouse is out-of-stock then it can be easily filled by the goods available in the nearest warehouse thus keeping the customer service level to the desired degree. In case of Clas Ohlson they have wait until the product is shipped from the central warehouse and this may take longer time and the operations will be at a standstill position for some time, which can be considered as a big disadvantage in case of Clas Ohlson. One more advantage with intercommunication between branches is that if they are operating a retail warehouse then the sales can be examined and could compete between themselves for better sales which is very less in case of Clas Ohlson.

### **Communication with Central warehouse**

In case of ÖoB, Clas Ohlson and Stadium the communication with the centralized warehouse is through internet or telephone and Åhlens is using WMS software which is deployed by the members of IGDS group. The advantages with the WMS software over the other methods are reduction in paperwork for inventory transactions, faster payback and inventory returns, reduced dependency on warehouse personnel and enhanced customer service. Considering these advantages, Åhlens has better operating conditions than the other three cases since the data updated in this case will be in a WMS environment and if there is any stock out problem, then that is automatically reflected in the computer systems at head office and can be immediately shipped to the respective departmental store. One disadvantage with WMS is its high installation cost; it is costly to have a WMS for all the branches which in turn adds to the warehouse operating cost.

### **Updating of stock**

In case of ÖoB and Clas Ohlson, the stock updating process is real time and data entry is done manually, in case of stadium the stock updating is done every 2 hours and for Åhlens it is real time updating with automated data entry. For ÖoB and Clas Ohlson the articles in the warehouse can be located at any point of time thus contributing to the effective inventory control management and thus leading to good warehouse management. The only delaying point in these two cases is the manual data entry that means it takes lot of time for the warehouse manager to enter the data of all the items and thus resulting is slow updating process although it is stated that the updating is done real time. There is some time lag in updating the systems due to the manual entry of the data into the systems by the warehouse personnel. In case of Åhlens, since the updating process is totally automated the location and quantity of the product is available at the finger tips of the warehouse manager, which means a very effective inventory control is available in case of Åhlens when compared to ÖoB and Clas Ohlson. Considering the case of stadium, the stock updating is done every 2 hours which can delay most of the warehouse operations and can result in ineffective inventory control.

Since for the 3 cases ÖoB, Clas Ohlson and Åhlens the stock updating is real time and linked to the central warehouse, any stock out problem will be easily tackled in these 3 cases immediately but the same process will be delayed in case of stadium due to late stock updating.

## **Method of communication with the suppliers**

The communication between the warehouses and the supplier is carried out by paperwork for ÖoB which is an obsolete method; on the contrary the communication within ÖoB is by using EDI. This means that the supplier for ÖoB is not able to afford for latest technologies. The communication in the case of Clas Ohlson and its suppliers is carried out completely by the central warehouse located in Dalarna and the local store is not at all involved in the process. The amount of inventory is planned and decided by the central warehouses. In the case of Stadium, the communication is carried out by paperwork and also by internet. Åhlens deploys latest technology i.e. a warehouse management system which is common for all the departmental stores which are within Intercontinental group of departmental stores (IGDS). The suppliers are insisted to install the same WMS for all the stores in the group in order to have some transparency in the information flow which increases efficiency and reduce errors at the same time.

## **Backup data**

Back up data is the copy of all the actual transactions or operations carried out in the warehouse. In all the cases the back up data is maintained and run at the end of the day. Backup data will be helpful in case of sudden computer failures or problems, which is a problem area in the case of ÖoB and Clas Ohlson.

## **Data retention period**

Data retention period has its own advantages such as, controlling the inventory levels for the future needs, estimating the sales, controlling the warehouse operations and designing the warehouse for better operating conditions. In case of ÖoB the data retention period is 1 year, since it is a retail warehouse this data will be of great use for the central warehouse in order to take decision on inventory levels and warehouse operations updating.

## **Planning horizon**

Planning horizon is the foreseen time for planning the inventory for the future demand. This involves filling up of the stocks in the warehouse when the goods are out of stock. According to the respective warehouse managers in the four cases, the planning horizon is appropriate according to there needs and requirements. In case of Clas Ohlson and Åhlens the planning horizon is done by the central warehouse, by which lot of work load is reduced for the warehouse managers in branch offices but it results in over burden for the central warehouses, because the number of SKU'S maintained are high in number for these cases. In case of ÖoB and Stadium the planning horizon is done within the local warehouses and this can reduce a lot of work to the central warehouse and has a lot of scope for the central warehouse to concentrate on other activities such as improving the operations and taking better decisions on inventory control levels.

## **Installation of WMS**

The advantages with the warehouse management software are faster payback and inventory returns, efficient-warehouse floor space utilization, reduction in paperwork for inventory transactions, improvement in cycle counting, reduced dependency on



warehouse personnel, enhanced customer service and improved labour Productivity. Some of the disadvantages are high cost, highly skilled labour required and proper training has to be provided. In the present case all the four warehouses are using the WMS in different environments and has its own advantages and disadvantages. In case of Åhlens, they are using WMS prescribed by IGDS group and its suppliers also in the same group which indicates that the Åhlens group has better advantage than the other warehouses, since there is a information exchange and transparency in the information flow between the central warehouse and its suppliers. whereas it is lacking in case of ÖoB, Clas Ohlson and Stadium although they are using different WMS. The WMS system used by ÖoB is called Enterprise system and the WMS used by Stadium works under Citrix environment. The data is not available for Clas Ohlson.

### 5.1.8. Problem areas

Table 5.8 Problem areas

Problem areas	ÖoB	Clas Ohlson	Stadium	Åhlens
	Untimely deliveries, Problems with computer systems	Data entry	Man power management	Man power management, Low resource utilization of the plastic boxes

**ÖoB:** According to the warehouse manager of the ÖoB (Borås) there are frequent problems with untimely deliveries. Normally, untimely deliveries lead to rescheduling of the processes in the warehouse which is a cumbersome process, which can consume lot of time and can affect the warehouse cost also. According to the theoretical part untimely deliveries can be of different types such delay by the third party logistician or delay at the central warehouse while carrying out any value adding activities etc. These untimely deliveries can be mitigated with perfect planning and regular surveillance of the whole warehouse process.

ÖoB (Borås) also having some problems with the computer system. Normally, system problems can create huge discrepancies in warehouse operations right from stock updating to product tracking. Such kind of delays results in ineffective warehouse operations which in turn can affect the customer service level. Problems in computer system has great effect on inventory control also which in turn affects the planning process and in case of problem persisting for longer time then the whole process gets delayed and also the real time updating at central warehouse can be affected to a great deal. In order to minimize such problems the warehouse should arrange for regular check up of computer systems i.e. once or twice in a month and also update the software they are using for any blockages.

**Clas Ohlson:** According to the warehouse manager of Clas Ohlson, there is a data entry problem in the warehouse while updating the stocks. The data entry problem is due to the warehouse management system they are using, which they think is not so user friendly. This problem is reported in Borås branch but may not be there in some other branches because of skilled employees who can work in any kind of software environment. It is

suggested that the employees should be given proper training in software which they are using, thus problems in data entry or some other computer related problems can be reduced.

**Stadium:** According to the warehouse manager of Stadium (Borås) the biggest problem is the man power management. They find it difficult to adjust an employee for another employee in case of sickness or some other problem. The problem arises when an experienced employee has to be adjusted, because without proper training it is difficult to handle the operations and moreover the number of singles items or the total inventory is high in the warehouse i.e. 55000 items. Improper labour management leads to extra warehouse cost. It is suggested that all the regular employees and extra employees need to be given proper training in order to run the warehouse operations smoothly. Problems like sickness are sudden things; which can be handled by effective adjustments of the employees within the warehouse.

**Åhlens:** According to the warehouse manager of Åhlens (Borås), the main problem in the store is the management of man power. It is a tedious effort to find a replacement for the employee in case of sickness or some other problem, which is the same in the case of Stadium as well. It is suggested that an effective labour management and the proper training of employee will definitely boost the overall performance of the warehouse. In Åhlens (Borås) the goods are stored in the plastic boxes. They prefer plastic boxes even though the cost is more, since most of the products are fragile type. According to the manager, sometimes the plastic boxes are not completely filled with products while they arrive from central warehouse resulting in low space utilization which adds to the warehouse costs. The problem with improper filling of boxes results in the usage of more plastic boxes which in turn increase the handling operations and also reduces the resource utilization which in turn increases the total warehouse cost. It can be suggested that the goods should be properly sorted at the central warehouse in order to utilize the resources to a maximum extent.

## **6. COMPARISON WITH THEORY**

In this chapter, a comparison of the empirical to the theoretical frame of reference is performed. All the main factors involved in warehousing which were described in theoretical as well as the empirical study are compared with each other to examine the situation in the real world.

### **6.1. Labour management**

According to the theoretical frame a basic challenge for all warehouse managers is allocating right number of people in the right place and at the right time to produce quality work. Warehouses with more number of employees result in high labour cost, low productivity and low profits. Alternatively with less staff there is a problem of employee burnout, quality problems and higher costs. It is very important for the warehouse managers to develop a plan which meets the day to day requirements, still keeping the overall cost to a lower level. It is a proven fact that labour management could cut down the costs to a considerable level arising due to labour, warehouses with a labour management system can save more on increasing resources.

Theoretically, warehouses with more number of employees results in high service level and at the same time high labour costs are involved adding to the total costs of the warehouse. The managers should decide on the optimum number of employees who can provide high service level and at the same time control the labour costs in the warehouse. According to Gunasekaran, H.B. Marri, F. Menci., 1999 about the training of the employees suggest that the employees should possess enough knowledge of newer technologies, complex processes, systems, machinery and the warehouse equipment. In order to achieve this, the warehouse personnel should undergo training which can give good results in the near future for a warehouse.

In earlier days the demand in the market was coped up by employing more number of unskilled labours for most of the operations. In the present business world this strategy is not recommendable due to extreme competition and outbreak of newer technologies within no time. The employees should be very skilful with good competency and qualification in order to match the requirements. The personnel driving the forklifts should have the knowledge of the driving and at the same time he should be accustomed to WMS used in the warehouse to perform the operations accurately and effectively. This involves training and holding meetings and classes frequently.

According to the theoretical frame, any kind of special training offered to the employees adds to the labour cost thus increasing total warehouse cost. On the contrary, the employees in almost all the warehouses are given training before they perform the actual work to handle the goods carefully and to follow systematic and standard methods in order to perform the job work efficiently without any risk of damaging the goods. The training given to the employees is mandatory to reduce the risk of damaging the goods due to mishandling and following very incorrect methods.

The results of the empirical study show that, the number of employees in ÖoB, Clas Ohlson, Stadium, Åhlens is 15, 20, 11 and 11 respectively. We can clearly observe that the number of employees in Clas Ohlson is higher than the other warehouses. In case of

Clas Ohlson, there are 20 employees which is quite high when compared to the other stores but due to the variety, range of the goods, high number of SKUs there is a requirement for greater number of employees to manage the warehouse effectively. The other two warehouses i.e. ÖoB and Åhlens employ 15 and 11 personnel to take care of the warehouse operations which are moderate when compared to Clas Ohlson.

In case of Stadium, they apply a very good strategy in order to maintain optimum number of employees. They have normally 11 employees and remaining 11 reserve employees are used during festive seasons and during the period of peak demands. These 11 employees are handy when somebody is sick or on vacation as well. They plan the man power as and when there is a peak demand such as festive season and during seasonal discount sales and during the remaining time they perform their operations only with 11 employees. In this way they strive to use the optimum number of employees at all times. This strategy helps them to reduce the labour cost and if the work load is more during the period of peak demands, then the reserve employees come into the picture. (Gunasekaran, H.B. Marri, F. Menci., 1999).

## **6.2. Warehouse floor space**

In any warehouse layout the first step is to calculate the overall space required for all the warehouse processes. The space requirements for the individual process should be calculated and summed up to estimate the overall building requirements. The space requirement calculation starts with receiving and shipping. Receiving and shipping staging is the space behind each dock door and normally the staging space should be able to accommodate a truckload's worth of material. Floor space requirements for packing, unitizing, customizing, accumulation, and sortation are calculated as a function of the floor space required for each work station in the specific areas, the number of work stations required, and the material handling methods employed in each area. In this way the floor space is to be calculated according to the requirement of the company and should be utilized in an efficient way.

ÖoB has a warehouse floor space of 2100 square meters which is higher than the other warehouses. This is understandable since ÖoB has a very wide product range and number of SKUs are also quite high. Due to this, they need bigger warehouse space to operate well with good efficiency. In the case of Stadium the floor space is 1000 square meters but the products are not bulky as in the case of ÖoB and Åhlens. In this way Stadium is saving the cost incurred by having bigger warehouse space. As the warehouse floor space increases, the rental incurred for hiring the infrastructure also increases which in turn increases the overall warehousing costs. (Briggs, 1978).

## **6.3. Storage methods**

According to theoretical frame, different types of racks have different advantages and disadvantages, for example double deep pallet rack require less number of aisles thus saving in warehouse space, whereas in case of single-deep pallet rack the amount of space devoted to aisles is much more thus occupying lot of warehouse space. (Briggs, 1978)

Considering the cases of ÖoB and Stadium, they are using traditional racks and aisles for storage and this arrangement has its own advantages and disadvantages, when compared

to other two cases. The racks and aisles do not come into picture in the case of Clas Ohlson and Åhlens, since these companies directly place the goods which are received on to the shelves of the retail store, thus completely eliminating the warehouse concept, since all the warehousing operations like sorting, packaging etc are done at their respective central warehouses.

Some retailers have increased their market share by reducing the prices and by providing more and more choices to the consumer. Choice and the reduced prices are accomplished by selling wide range of standardised goods in high volumes through large outlets. Sale of food products and bulky goods are some of the examples. The current situation has given rise to many superstores, hypermarkets and warehouses, and these operators are not in a position to pay high rents for the premises built in the expensive sites. So the operators are opting for premises with low rent and good parking facility in off centre locations mainly outskirts of cities. These facilities are called the retail warehouses which eliminate the need for the warehouses in the system. The goods are shipped from the central warehouses to the local retail warehouses where the goods are not stored in a warehouse; instead the goods are directly placed on their respective shelves in the retail store. Thus, eliminating the warehouses in between the central warehouse and the departmental stores.

In the case of ÖoB and Stadium, these warehouses should bear the warehouse costs generated by the functioning of the warehouse. On the contrary, Clas Ohlson and Åhlens are adopting a strategy to completely eliminate the concept of warehousing; they are placing the received goods directly into the shelves of the retail store which cuts down the cost of having a warehouse. All the warehousing operations such as sorting, packaging etc. are carried out in their respective centralised warehouses and the goods which are ready to store are then shipped to their respective individual departmental stores all over Sweden. This strategy is very much advantageous for Clas Ohlson and Åhlens over ÖoB and Stadium which have a warehouse for every departmental store.

According to the theoretical part, any kind of special security systems adds to the warehouse cost but that is mandatory for safe operations of the warehouse activities and to prevent theft in the warehouse which can cause lot of problems in terms of costs.

## **6.4. Inventory management**

According to theoretical frame, inventory control has been represented as the function of management of forecasting, exploring requirements, setting up targets and issuing instructions. The monitoring of stocks in the warehouse is considered to be basic supervisory function, which requires more skill and experience. Overlooking of monitoring and measurement process results in unreliable and low quality inventory management due to the lack of feedback information on which management depends to determine the effect of its instructions.

The monitoring and measurement of inventory is not merely a stock checking process but also to know everything about the stock at all times, to ensure effective management of the warehouse, and to provide accurate feedback of data for management of the business, including sales order purchasing inventory control, processing and invoicing. Monitoring is the knowledge of the progress of materials and goods as they are processed through the warehouse. The one which monitors the entire process rather than

just stock is considered to be the best system. This indicates that monitoring and measurement take place after each and every action thus pointing out any errors immediately. Elimination of errors reduces the need for periodic stock check. (Ballard, 1996).

In the present case, we don't have much information about number of articles in ÖoB and Clas Ohlson. Stadium and Åhlens have 55000 and 20000 articles as inventory respectively. In case of Åhlens, the number of articles to be monitored is less compared to Stadium with respect to equal number of employees, which means that Åhlens has scope for good inventory management when compared to stadium due to less number of articles. This also results in effective information sharing within Åhlens and assisting the warehouse operations in a great deal and reducing the errors.

Considering warehouse space as the comparison factor, Åhlens has 2000 square meters and Stadium has 1000 square meters of floor space, so the number articles to warehouse space in Åhlens is less compared to Stadium that means the monitoring of stocks is easier in case of Åhlens than Stadium, which results in good quality inventory management. Åhlens has the advantage of good inventory control at the cost of low warehouse space utilization, which means that the warehouse floor space is not being utilized well in case of Åhlens.

## **6.5. Packaging and protection of the goods**

According to the theoretical frame the packaging materials such as plastics, corrugated cardboards, slips sheets etc. have there own advantages and disadvantages. In most of the cases corrugated card board boxes are preferred to plastics since they can be broken down easily thus reducing the amount of space occupied by them in the warehouse after they are used. Corrugated card board has high compression strength and available in different sizes and designs. Corrugated card boards are not too expensive and they are affordable by the companies. Plastics are cleaner and safe to use and they are also reusable and can be recycled, but the initial cost is higher than that of a cardboard. (Wills 2007).

In the present study, ÖoB and Stadium are using corrugated card board boxes as packaging material. On the other hand, Clas Ohlson and Åhlens are using plastic boxes as packaging materials. Since the product type handled by ÖoB and Stadium are groceries and sporting material respectively which are not much fragile in nature, they prefer corrugated card board boxes, and the products handled by Clas Ohlson and Åhlens are fragile and delicate in nature such as glass ware, ceramics, electronic goods, hence they prefer plastic containers for extra protection even though the cost is more.

Customized packaging needs skillful labour and extra resources to perform, thus adding the total warehouse costs. In the present case all are retail warehouses do not perform any customized packaging operations and value adding activity, since all are retail stores and they are at the edge of the end customers.

## **6.6. Handling and security of the goods**

According to the theoretical part, any kind of special training to the employees adds to the labour cost, thus increasing total warehouse cost, but in the present case since the damage of occurrence is very low and no special training is required so it does not have much effect on the warehouse cost. (Gunasekaran, H.B. Marri, F. Menci., 1999).

In all the cases, the frequency of damage is very less as mentioned by their respective warehouse managers. The damage compensation is compensated by the employee himself in the case of ÖoB and Åhlens and compensated by company in the case of Clas Ohlson and Stadium, thus the damage compensation bore by the company cases add to the warehouse cost. In the present cases, since the damage occurrence within the warehouses is very less, it does not have much effect on the warehouse cost. In case of Åhlens, no special training is given to the employees and moreover they have to handle fragile goods. Due to these reasons the employees have extra pressure and work load in handling the goods.

Theoretical part strongly accepts the point there should be a contingency plan for the power failure in warehouses in order to maintain the smooth running of the operations even though it adds to the total warehouse cost. The warehouses must always have some security systems in order to prevent any theft since the goods in the warehouse are of enormous value in terms of money. But any kind of special security systems if deployed adds to the warehouse cost but that is mandatory for safe operations of the warehouse activities.

According to the theoretical standards all the warehouses should operate under strict rules and regulations of accidental damage, thus making it mandatory for the installation of fire alarms and extinguishers. These standards are set by the fire protection service which should be complied with the original specifications.

According to the rules and regulations in Sweden, all the warehouses should comply with specific standards of fire safety, thus forcing the companies for the compulsive installation of fire alarms and extinguishers. All warehouses in the present case are equipped with fire alarms and extinguishers according to the required standards of fire protection service.

## **6.7. Identification of goods**

According to the theoretical frame, manual entry of information into the computer systems in a warehouse requires multi- entry of data, which is a mere waste of time, expensive and also gives scope for many manual errors. Auto-ID is the use of tools and techniques to identify and gather the information about a physical object without any human intervention.

The Auto-ID system can automatically identify the objects, collect the data about the objects and can enter the data captured into the computer systems without any human involvement. Some of the prominent types in Auto ID are barcodes and RFID.

RFID is a latest technology which is being used by most of the large scale businesses and it has many advantages over barcodes.

All the warehouses in our case are using the barcode technology to identify the goods and the identification is done manually by sensing the barcode with the help of a barcode reader. This is the most common method used in the warehouses nowadays. The present warehouses are not really indulging into deploying latest technologies like RFID and other auto identification processes due to the high initial investment costs and the businesses have a fear of not getting the payback in the near future after installing Auto-ID or RFID technologies.

Most of the warehouses are adapting to a mixture of both conventional as well as the new technologies in order to limit the overall cost for installation of the technology. Although, new technologies enable the warehouses to automatically identify the goods when they are received, the present four warehouses are still using the conventional barcode system by identifying the goods manually by hand.

## **6.8. Communication through computers**

In the earlier days, computer was used to provide detailed information of the inventory levels and the other transactions like orders and invoices to the management. This was only a passive use of the computer and all the information was again printed on reams and rolls of papers which were handed over to the operating managers in order to give the overview of the inventory status of the warehouse. Nowadays, computer has been transformed into much more effective and efficient tool for warehouse management. (Raymond A. Nelson, 1985)

All the warehouses use the computer as an operating tool which is integrated with the physical and control operations of the warehouse. The computer now acts almost like a human brain and it is always online and it can receive, retrieve and provide the necessary information and at the same time updates the records which help to control the warehouse operations efficiently. This can be accomplished in real time without any time lag for the updating the information. For instance, when an order is placed, the inventory can be allocated as soon as the order is placed, when the order is shipped out, the inventory can be reduced. When the goods are received and stored, the inventory is automatically updated and is available at that moment for new orders.

All the warehouses in the case study are computerized warehouses and the data is fed into the computer systems and there is very less paperwork in the system in order to decrease the time taken for entering the data and maintaining the transactions taking place in the warehouses like invoicing, receiving documents etc.

## **6.9. Warehouse management systems**

In the theory, advantages of deploying a WMS are mentioned which is very helpful for a warehouse to attain good efficiency. Most of the warehouses in the present world are using WMS and getting some good results. Warehouse management system is a pivotal part of the supply chain which primarily controls the storage and movement of materials within a warehouse and processes the transactions, including shipping, receiving, putaway and picking. WMS also enables in directing and optimizing stock putaway based on real-time information about the status of bin utilization.



The advantages with the warehouse management software are faster payback and inventory returns, efficient-warehouse floor space utilization, reduction in paperwork for inventory transactions, improvement in cycle counting, reduced dependency on warehouse personnel, enhanced customer service and improved labour Productivity. Some of the disadvantages are high cost, highly skilled labour required and proper training has to be provided. (Hompel,Ten.,Michael ., Schmidt, Thorsten., 2007).

In the present case all the four warehouses are using the WMS in different environments and has its own advantages and disadvantages. In case of Åhlens, they are using WMS prescribed by IGDS group and its suppliers also in the same group which indicates that the Åhlens group has better advantage than the other warehouses, since there is a information exchange and transparency in the information flow between the central warehouse and its suppliers. whereas it is lacking in case of ÖoB, Clas Ohlson and Stadium although they are using different WMS. The WMS system used by ÖoB is called Enterprise system and the WMS used by Stadium works under Citrix environment. The data is not available for Clas Ohlson.

## **7. CONCLUSIONS**

In this chapter, a summary of the key findings and discussion about the attained key findings is provided. It also expresses the final conclusions which were developed on the theoretical, empirical studies and the analysis part of the thesis work.

### **7.1. Overview**

The purpose of this thesis work is to give an overview and to understand deeply the concept of "Warehousing", which is defined and interpreted in theory and practice. In order to get an overview, both theoretical and empirical studies are conducted. The theoretical study is conducted by carrying out a research work on relevant literature through textbooks, scientific articles, internet etc. In the empirical study, we investigate the present state of the warehouses and examine whether the case companies utilize the practices that the literature points out based on theoretical background. The empirical study is implemented by interviewing warehouse managers of four firms with the help of a questionnaire.

### **7.2. Present situation**

In the present competitive world, the new warehousing techniques such as enhancement in receiving functions etc are tend to be outdated by the time the infrastructure is being arranged to implement the new ideas. This is the phase of the warehousing industry nowadays in which an organization should strive to be more efficient and effective than the other competitors. They must implement some sophisticated technologies very effectively in order to stay in the competition.

The problem in the warehouses is that the old and conventional methods which are obsolete are combined with very crowded conditions. This may result in very slow material movement and this leads to increase in inventory holding costs and also increase in the operating costs. The businesses will not tolerate this increase in costs; hence there is always a quest for newer and better methods. However, merely installing the newer methods does not mean that the system is effective and efficient, there is also necessity of a strong supervisory organization of the system to make the methods more effective and this also requires lot of training and managing the operations. (Tompkins, Smith, 1998).

Considering the present cases, all the warehouses are deploying some of the latest technologies such as WMS and it is observed that they are getting some good results by doing so. Although they are using technical advancements in some areas, they are also opting for very traditional and old techniques such as identifying the received goods manually where there is a scope for automation. Nowadays, businesses are implementing the Auto-ID technique in order to reduce the time of identification of goods which is very tedious job to perform, this was as stated by the warehouse managers of the present case companies.

We can also observe that some of the cases in the empirical study communicate with the suppliers, freight forwarders or the central warehouse still through internet, telephone or fax. There are plenty of options available in today's world for communication such as

EDI, XML and WMS. They are hesitating and reluctant in implementing the new technologies due to the fact that the technologies are very expensive for the businesses. One more reason could be that the suppliers or the freight forwarders are not able to afford all these technologies even though the present case companies are willing to do so. (Raymond A. Nelson, 1985)

The present warehouses are in the situation, where there is a speculation of which strategy can give the warehouses the best results and the warehouse managers are very sceptical and apprehensive over the use of the latest technologies or the traditional warehousing methods in order to maintain the warehouse efficiently at the same time gets good results for the organizations. The recent developments in the warehousing lead to Retail Warehouse concept, wherein the goods are placed directly on the shelves for the end customers, thereby eliminating the storage function or need for any separate warehouse. (Henneberry, 1987)

The retail warehouse concept is already very prominent in the businesses, Clas Ohlson as well as Åhlens is adapting the concept of Retail warehousing thus eliminating the need for a warehouse. On the contrary, the other two cases ÖoB and Stadium are still going with the warehousing concept which ties up to the over all costs of the company. These companies have scope of converting into retail warehouses and reduce the tied up capital which arises due to the warehousing.

### **7.3. Problem areas**

The present cases are facing some problems in the computerization as well as the labour management in the warehouses. This can be due to the lack of knowledge in computers and also due to lack of managerial skills. These can be eliminated only by giving a rigorous training for the employees in order to reduce the human errors in the system and also manage the resources and man power efficiently.

### **7.4. Final Conclusions**

Even though, there are enormous numbers of technologies available in the market, the companies are still hesitating to upgrade their warehouses due to the fear of high initial costs which are incurred due to the upgradation. The warehouses are playing a safe game by implementing some new technologies but not completely switching to the modern warehousing concept which is also called the paperless system. They are carrying on with the traditional warehousing concepts but at the same time improving some areas where there is a need to do so.

### **7.5. Scope for future research**

This research work has been performed only in the warehouse perspective. Further research work can be carried out in the perspective of the supplier as well as the customer to examine the problems faced by them which also effects the warehouses.

There is also scope for detailed inspection of the present warehouses to find out the main loop holes and bottle necks in the system in order to solve the problems arising due to the warehouses.

The research work carried out is purely based on qualitative methodology. There is still scope for a researcher to carry out a detailed quantitative study on the present topic in order to get good knowledge of the present situation.

## REFERENCES

### Literature

Briggs, J. Andrew., 1978; *Warehouse operations planning and management*, Robert E. Krieger publishing company, Huntington, New York.

David, J. Viale., 1996; *Inventory Management: From Warehouse to Distribution Center*, Menlo Park, CA, USA: Course Technology Crisp.

Donald, F. Wood., 1990. *Contemporary Logistics*, 4th edition, Macmillan publishing company, USA.

Frezelle, H. Edward., 2002; *World class warehousing and material handling*, McGraw Hill, USA.

Geoffrey, Marczyk., DeMatteo, David ; Festinger, David., 2005 ; *Essentials of Research Design and Methodology*, John Wiley & Sons, Inc, New Jersey.

Hompel, Michael Ten., Schmidt, Thorsten., 2007; *Warehouse management: Automation and organisation of warehouse and order picking systems*, Springer-Verlag Berlin Heidelberg.

Harmon, L. Roy., 1993; *Re-inventing the warehouse: World class distribution logistics*, Maxwell Macmillan, Canada inc.

Jenkins, H. Creed., 1968; *Modern warehouse management*, McGraw-Hill Book Company.

Jonsson, Patrik., Mattsson, Stig-Arne., 2005; *Läran om effektiva materialflöden*, Lund Studentlitteratur.

Kumar., 2005; *Research methodology: A step by step guide for beginners*, Sage Publications, London.

Lumsden, R. Kenth, R., 2006; *Fundamentals of logistics*, Chalmers University of Technology,.

Mulcahy, E. David ., 1994; *Warehouse distribution and operations handbook*, McGraw Hill, USA.

Mentzer,T. AvJohn., 2001; *Supply Chain Management*, Edition: 2,Publicerad av SAGE.

Nelson, A. Raymond. ,1985; *Computerizing warehouse operations*, Prentice- Hall, Inc., Business and professional division, Englewood cliffs, New Jersey.

Napaitano, Maida., 2003; *The time, space and cost guide to better Warehouse design*, 2<sup>nd</sup> edition, Alexander communications group, Distribution group, New York .

Simchi-Levi ,E.David., Philip Kamnisky., 2002; *Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies*, London, UK: Irwin/McGraw-Hill.

Shapiro,D. Roy., Heskett, L. James., 1985; *Logistics Strategy: Cases and Concepts* ,St. Paul, Minn: West.

Tompkins,A. James., Smith,D.Jerry D., 1998; *The Warehouse Management Handbook*, Tompkins press.

Taylor, H. David., 1997; *Global cases in Logistics and Supply chain management*, International Thomson Business Press.

## **Articles**

Axel Johnson AB; Axel Johnson AB and our group companies, 2007.

Aitken.j.Christopher.j. Aitken.,. towill. D ,2001, “*understanding, implementing and exploiting agility and leanness*”, paper presented at UK Symposium on supply chain alignment , liver pool university, Liverpool.

Baker, Peter., 2007; *An exploratory framework of the role of inventory and warehousing in international supply chains*, Emerald Group Publishing Limited, .

Ballard, R.L., 1996; *Methods of inventory monitoring and measurement*, Logistics Information Management, Volume 9, Issue 3.

Cooper, J.C, Davis. Matthew, 1984; *Why have a warehouse?*, MCB UP Ltd, Volume 12, Issue 5, Page 66 – 68.

Carlson, Brian., 2005; *Supply Chain Execution: Looking Beyond the Four Walls of the Warehouse*.

Dymond, Mike MILT.,2007; *Warehouse Labour Management comes of age*, The Chartered Institute of Logistics and Transport (UK), FEB .

FKI Logistex, 2005 *RFID for the Real World: Challenges and Opportunities in the Warehouse and Distribution Center Environment*.

Flanders, Sam.,2002; *Voice Directed Picking A Technology that is Ready for Prime Time*, 2wmc.com Consulting Group, Inc..

Garner, Chris; *The contribution of ISO 9000 Certification*.

Gunasekaran, H.B. Marri, F. Menci., 1999 *Improving the effectiveness of warehousing operations: a case study*, *industrial Management & Data Systems*, MCB UP Ltd, Volume , 99, Issue 8, Page 328- 339.

Hill, John M., 1995; *Warehouse management systems: Vital link in supply chain*, Automatic I.D. News, 08909768, Mar1995, Vol. 11, Issue 3 (Business Source Premier).

H. MIN., 2006; *The applications of warehouse management systems: an exploratory study*, *International Journal of Logistics: Research and Applications*, Taylor & Francis, Volume 9, Issue 2, Page 111-126.

Henneberry, John, 1987; *The Evolution of the Retail Warehouse and its impact on other retail outlets*, MCB UP Ltd, Proper Management, volume 5, Issue, Page 254- 261.

IFS Customer Story, 2007; *Stadium Meets Future Customer Demands*, Production IFS Global Marketing.

Hoek, I., Remko., 2006, *Agile Supply Chain*, Emerald Group Publishing

Koster, M.B.M. De; Warffemius, P.M.J., 2005, *American, Asian and third-party international warehouse operations in Europe: A performance comparison*, Emerald Group Publishing Limited, International journal of Operations & Production Management, Volume 25, Issue 8, Page 762- 780.

LXE, 2007; *Key Enablers for an Efficient & Optimized Voice-Based Warehouse, Critical Insights to Selecting a Comprehensive Voice-Based Warehousing Solution*, LXE Inc.

Mamo, Anthony., 2004; *RFID VS Barcodes*, Electro-Com (Australia) Pty Ltd.

M.I. Suhile Ahamed, 2004; *Electronic cargo tracking: an RFID based technology*, Version 1.0.0.

Morley, Stuart., 2003; *Retail warehouse performance*, Henry Stewart Publications, Journal of Retail & Leisure Property, Volume 3 issue 2, page 142- 149.

Nemoto, Toshinori ., Tezuka, Koichiro., 2002; *Advantage of Third Party Logistics in supply chain Management*.

Rizzi, Antonio., Zamboni, Roberto., 1999; *Efficiency improvement in manual warehouses through ERP systems implementation and redesign of the logistics processes*, MCB UP Ltd, Logistics Information Management, volume 12, Issue 5, Page 367- 377.

Transport and distribution management technology, 2006; *RFID Technology for Warehouse and Distribution Operations*.



Werling, Chris.,2006; *Tomorrows Warehouse*, Corner Stone Solutions, Inc.

Wills, Gordon., 2007; *Packaging as a source of profit* ,emerald.

## **Internet links**

### **Afterbug.com**

<http://www.afterbug.com/smart-card.shtml> , 2008

### **Axel Johnson.se**

1. [http://www.axeljohnson.se/Upload/Om%20oss%20i%20fickan/AXJ\\_0020\\_koncernpres\\_engelsk.pdf](http://www.axeljohnson.se/Upload/Om%20oss%20i%20fickan/AXJ_0020_koncernpres_engelsk.pdf) , 2008
2. <http://www.axeljohnson.se/Pages/Presentationpage.aspx?id=94&epslanguage=EN-GB> , 2008

### **Åhlens.com**

1. <http://www.ahlens.se/> ,2008
2. [http://www.ahlens.com/common/bottom\\_menu/in\\_english.html](http://www.ahlens.com/common/bottom_menu/in_english.html) , 2008

### **Answers.com**

<http://www.answers.com/topic/barcode> , 2008

### **BU School of theology**

[http://sthweb.bu.edu/index.php?option=com\\_awiki&view=mediawiki&article=Barcode&Itemid=174](http://sthweb.bu.edu/index.php?option=com_awiki&view=mediawiki&article=Barcode&Itemid=174) , 2008

### **California Transportation and Logistics Institute**

<http://www.laedc.org/catli/glossary/l.html> , 2008

### **CPM.z80.de**

[http://www.cpm.z80.de/manuals/DrLogo\\_Ref\\_App.txt](http://www.cpm.z80.de/manuals/DrLogo_Ref_App.txt) , 2008

### **Clas Ohlson**

[www.clasohlson.co.uk](http://www.clasohlson.co.uk) , 2008

<http://www.clasohlson.co.uk/Template/Template1.aspx?id=217670> ,2008

### **Doubleinfinity.net**

<http://doubleinfinity.net/page/2/> , 2008

**DHL.com**

[http://www.dhldiscoverlogistics.com/cms/en/course/management/logistical\\_net\\_plan/degree.jsp](http://www.dhldiscoverlogistics.com/cms/en/course/management/logistical_net_plan/degree.jsp) , 2008

**Electrocom.com**

<http://www.electrocom.com.au/> , 2008

**Emediawire.com**

<http://www.emediawire.com/releases/2004/7/emw143175.htm> , 2008

**Emhain.wit.ie**

<http://emhain.wit.ie/~pwall/CvD.htm> , 2008

**EOH Logistics IT**

<http://logistics.ct.eoh.co.za/WHM.php> , 2008

**Ezinearticles.com**

<http://ezinearticles.com/?Warehousing-Costs&id=278561> 2008

**Fkilogistex.com**

[http://www.fkilogistex.com/pdf/white-papers/RFID\\_Real\\_World\\_WP.pdf](http://www.fkilogistex.com/pdf/white-papers/RFID_Real_World_WP.pdf) , 2008

**Global Sources.com**

<http://www.globalsources.com/PEC/PROFILES/AHLENS.HTM> , 2008

**Hercules.gcsu.edu**

[hercules.gcsu.edu/~adsit/files/2007-09-17,%20Chapter%208.ppt](http://hercules.gcsu.edu/~adsit/files/2007-09-17,%20Chapter%208.ppt) , 2007-09-17

**Impomag.com**

<http://www.impomag.com/scripts/ShowPR.asp?RID=7755&CommonCount=0> , 2008

**Inneresteem.com**

<http://www.inneresteem.com/CompanyProfile.htm> , 2008

**Inboundlogistics.com**

<http://www.inboundlogistics.com/glossary/l.shtml> , 2008

**Industry Canada**

[http://www.ic.gc.ca/epic/site/dsib-logi.nsf/en/h\\_pj00142e.html](http://www.ic.gc.ca/epic/site/dsib-logi.nsf/en/h_pj00142e.html) , 2008

**IT.toolbox.com**

<http://it.toolbox.com/blogs/wms-essentials/what-is-warehouse-management-system-wms-18819> , 2008

**IFS World.com**

1. <http://www.ifsworld.com/customers/stadium2.asp> , 2008

2. [http://www.ifsworld.com/solutions2/components\\_fact\\_features/distribution/default.asp#](http://www.ifsworld.com/solutions2/components_fact_features/distribution/default.asp#) , 2008

3. [http://www.ifsworld.com/binaries/Stadium\\_tcm31-31592.pdf](http://www.ifsworld.com/binaries/Stadium_tcm31-31592.pdf) , 2008

**Juliantrubin.com**

<http://www.juliantrubin.com/encyclopedia/engineering/barcode.html> , 2008

**MHMonline.com**

<http://www.mhmonline.com/nID/3904/MHM/viewStory.asp> , 2008

**Naxtor Technologies:**

1. <http://www.warehouse-solutions.com.au/index.php/the-naxtor-%20%20%20wms-warehouse-and-distribution-management-system-an-overview/> , 2008
2. <http://www.warehouse-solutions.com.au/index.php/what-is-warehouse-management-%20system-wms/> , 2008
3. <http://www.warehouse-blog.com/index.php/2007/07/> , 2008

**Overskottsbolaget.se**

[www.overskottsbolaget.se](http://www.overskottsbolaget.se) , 2008

**Querycat.com**

<http://www.querycat.com/faq/86aed36162dafc1b3b158fe750790c07> , 2008

[http://en.wikipedia.org/wiki/Just\\_In\\_Time\\_\(business\)](http://en.wikipedia.org/wiki/Just_In_Time_(business))

**Research.ittoolbox.com**

<http://research.ittoolbox.com/white-papers/backoffice/scm/supply-chain-execution-looking-beyond-the-four-walls-of-the-warehouse-2714> , 2008

**ro.uow.edu**

<http://ro.uow.edu.au/thesesinfo/9/> , 2008

**Runsven.se**

<http://www.runsven.se/Default.aspx?id=1> , 2008

**Rajab12.blogspot.com**

[http://rajab12.blogspot.com/2006\\_09\\_01\\_archive.html](http://rajab12.blogspot.com/2006_09_01_archive.html) , 2008

**Reference.com**

<http://www.reference.com/browse/Datastrip&> , 2008

**Referenceforbusiness.com**

<http://www.referenceforbusiness.com/management/Tr-Z/Warehousing-and-Warehouse-Management.html> , 2008

**Stadium.dk**

1. <http://www.stadium.dk/content.asp?CategoryID=4962&ArticleID=10975&OID=277&MenuID=262&LanguageID%2059> , 2008
2. <http://www.stadium.fi/content.asp?CategoryID=4962&ArticleID=10975&OID=277&MenuID=262&LanguageID=91> , 2008
3. [www.stadium.dk](http://www.stadium.dk) 2008

**Supercorridor.com**

<http://www.supercorridor.com/store/main/about.html> , 2008

**SDCExec.com**

<http://www.sdccexec.com/online/article.jsp?id=9090&siteSection=4> , 2008

**Shippensburg university**

<http://www.ship.edu/academic/buslog.html> , 2008

**Wikipedia:**

1. <http://en.wikipedia.org/wiki/Logistics> , 2008
2. [http://en.wikipedia.org/wiki/Supply\\_chain\\_management](http://en.wikipedia.org/wiki/Supply_chain_management) , 2008
3. <http://en.wikipedia.org/wiki/Warehouse> , 2008
4. [http://en.wikipedia.org/wiki/Warehouse\\_management\\_system](http://en.wikipedia.org/wiki/Warehouse_management_system) , 2008
5. <http://en.wikipedia.org/wiki/%C3%85hl%C3%A9ns> , 2008
6. [http://en.wikipedia.org/wiki/Axel\\_Johnson\\_AB](http://en.wikipedia.org/wiki/Axel_Johnson_AB) , 2008
7. [http://allrss.com/wikipedia.php?title=Bar\\_code](http://allrss.com/wikipedia.php?title=Bar_code) , 2008
8. [http://en.wikipedia.org/wiki/Bar\\_codes](http://en.wikipedia.org/wiki/Bar_codes) , 2008
9. [http://en.wikipedia.org/wiki/Smart\\_cards](http://en.wikipedia.org/wiki/Smart_cards) , 2008
10. <http://en.wikipedia.org/wiki/RFID> , 2008
11. <http://en.wikipedia.org/wiki/%C3%85hlens> , 2008
12. [http://en.wikipedia.org/wiki/Magnetic\\_stripe\\_card](http://en.wikipedia.org/wiki/Magnetic_stripe_card) , 2008

## **Interviewees**

Jan Johansson, Warehouse manager of Åhlens AB, Lilla Brogatan 8, Borås

Lech Kaczorek, Work Leader at Clas Ohlson, Knallerian, Knalleland

Joakim Persson, Warehouse manager of ÖoB, Knalleland, Borås

Patrik Ryden, Store manager of Stadium, Knalleland, Borås

## **APPENDIX**

### **Questionnaire for the interview**

**Name of the Company/Warehouse:**

**Person Responsible:**

**Designation:**

**Email ID:**

**Contact number:**

#### **Interviewers:**

Mahesh Kumar Rajuldevi (Mahesh13kumar@gmail.com, S062783@utb.hb.se)  
Ranjit Veeramachaneni (ranjit.veeramachaneni@gmail.com, X060076@utb.hb.se)  
Sridhar Kare (karesridhar@gmail.com, X060075@utb.hb.se)

#### **Thesis guide:**

Goran Stjernman (goran.stjernman@hb.se)

Head of Department: Industrial management and Logistics

#### **Hogskolan I Borås**

#### **General information:**

1. How many employees are working in the warehouse?
2. Are the employees given training for various operations in the warehouse?
3. From how long is your company operating this warehouse?
4. How many warehouses are operated by your company?
5. Does your warehouse have any ISO certification?
6. How many suppliers do you have and how many customers do you serve?
7. What is the total Warehouse floor space?

#### **Storage and operations:**

8. What are the storage methods used to maintain the warehouse? Are there any special or customized storage methods?

9. How many different carton or pallet sizes are used in handling in the warehouse?  
Is there any standard size of pallets for your warehouse?
10. What is the type of product stored in the warehouse and if there are many, then how many different SKUs are maintained in the warehouse?
11. What is the method for the identification of goods and data entry? (Bar codes, RFID etc.)
12. What are the loading and unloading methods used in the warehouse for the handling purposes? (Fork lift, Manual, Conveyer belt, Mini Crane, Counter balanced truck etc.)
13. What is the total inventory level in item units?
14. How do you maintain the inventory level for seasonal demand?
15. How many different packaging materials are used in the warehouse?
16. Is there any value adding activity in your warehouse?
17. Do you have any specific/customized packaging method for some specific customers?
18. What is the value of on hand inventory in terms of SEK?

**Handling goods and security:**

19. What is the frequency of damage occurrence and what are the measures taken to reduce them?
20. How do you compensate the damage occurred during handling of the goods?
21. How do you provide security for your goods in the warehouse? (Security alarm, Security personnel etc.)
22. Is there any contingency plan for power failure and in case of any other devastations like fire etc.?

**Data entry, planning and communication:**

23. Is there any intercommunication and co-ordination between the warehouses?
24. Is your central warehouse having any specific approach for the communication between all the warehouses?

25. Does your company outsource any logistics operation? If yes, do you have control over the operations which are outsourced?
26. Is the stock information updated real time? If no how frequently is it updated? (Time delay)
27. How is the updating done? ( Paperwork or computerization )
28. Does your company exchange data within customers and suppliers? If yes, what is the method of communication? ( Fax, email, EDI or paper work )
29. How does your warehouse maintain backup data?
30. What is your data retention period? ( Paperwork or computer system )
31. What is your planning horizon in terms of time? (Week, Day, Month, Hours etc.)
32. Do you have any specific Warehouse management system assisting your warehouse?

**Problem areas:**

33. What are your constraints and opportunities? Are you having temporary solutions for the problems?
34. Do you have any specific problem in any of the operations performed in the warehouse?