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WAREHOUSE OPTIMIZATION BEDNAR FMT

Bachelor's Thesis

Business Logistics

April 2015

KYAMK
University of Applied Sciences

Author (authors)	Degree	Time
Michal Matyi	Bachelor of Business Logistics	April 2015

Thesis Title	42 pages
Warehouse Optimization BEDNAR FMT	3 pages of appendices

Commissioned by

BEDNAR FMT, s. r. o.

Supervisor

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Abstract

The thesis Warehouse Optimization BEDNAR FMT was focused on warehouse analysis. The main objective was to propose solutions how to improve warehouse operations The management of the company BEDNAR FMT was not satisfied because there were many issues and constrains with warehouse operations. The company was struggling with increased inventory levels because their business activities were increasing as well.

Analysis of warehousing related literature was used for theoretical framework which served as a foundation for the empirical part of thesis. The study was initiated with recognition of the problem. In the begining , all warehouses were analysed and the main constrains were identified. In order to propose the solutions for improvement, several meetings and brainstorming sessions were held. With these meetings it was easier to identify the problems and propose the optimal solution.

After the warehouse analysis, the main problem was recognized in marketing warehouses. The operations there were unorganized and lacking any proper inventory management or warehouse management system. In that state, the marketing department was unable to satisfy the demand of warehouse customers, mostly sales representatives, for marketing related products. During the meetings, two options for improvement were motioned – to move promotional products to spare parts warehouse and facilitate the responsibilities for marketing department. The second option was to perform a complete reorganization of current warehouses.

After considering all pros and cons, second option was chosen as the most advantageous one. The proposal included new warehouse layout, WMS implementation, development of a location system and a solution how to prioritize inventory items. The second option also considered continuous improvement and quality management systems. Although the main objective was accomplished – the solution how to improve the warehouse operations were presented – some of the improvements (ABC analysis) could not be performed because at that moment the company could not provide relevant data for it.

Keywords

logistics, warehousing, optimization, efficiency, analysis

CONTENTS

1 INTRODUCTION

Logistics belongs to the most common part of almost every company. By effective logistics, the management of a company can achieve lower costs, shorten time to delivery and, moreover, improve the entire fluent function of the company. Logistics is not only dealing with issues related to transportation of goods as many people think, but it consists of many elements integrated in supply chain. One indivisible part of supply chain is a warehouse. The key role of warehousing in supply chain is receiving/issuing of goods, storage, packaging or assemblage.

The reason why companies should focus on warehousing is simple – warehousing costs present significant share of companies' operational costs. They can account for around 22% off all costs for logistics. This thesis is focused on optimization of logistics processes mostly related to warehousing. (Richards, 2014, p. 276)

With the experience gained during my internship in a company which manufactures farming machinery, I came to realize that warehousing management plays important role in company's business. There were too many incidents of materials being out of stock, item losses and the warehouse stock level not corresponding with the level in the records, which caused many problems and brought additional costs or expenses. In this thesis, I am going to analyse the current state of this problem and come up with a solution how to improve it.

Main objective

The main objective of this thesis: How to improve company's warehouse processes.

In order to achieve this objective several sub-questions need to be considered:

- What are the parameters of current warehouses?
- What is the main cause of problems?
- What are the options for improvement?

Research methods

Analysis of warehousing related literature will be used as a research method for theoretical framework.

The empirical part will be mostly based on formal or informal discussions and meetings with employees of the company who are responsible for warehouses. During these discussions and brainstorming sessions we can gain multiple opinions on this matter and choose the best option for the company. First, an analysis of current state of warehouse processes needs to be done. After that it is possible to make suggestions for improvement.

My four-month internship in this company gave me an opportunity to observe its practices and be a part of the company. The result of the study could serve as a guideline for the company and show how to optimize these processes to achieve better performance and to avoid undesirable losses.

2 EFFECTIVE LOGISTICS

Logistics has many viewpoints or definitions, therefore it is not possible to find the correct one. There are some definitions convenient for the purpose of this study.

Logistics is a systematic approach with a main objective to optimize material or information flows across different systems. (Hompel & Schmidt, 2007, p. 13)

Logistics strategically manages the material flow (procurement, storage or movement) and information flow to ensure maximal profitability and cost effectiveness. (Chrisopher, 2011, p. 2)

The main purpose of logistics is to reach required level of customer satisfaction by efficient and effective movement of materials within the whole supply chain. (Vinod, 2007, p. 2)

To optimize these flows there are four core elements that make the logistics processes effective. These elements have either effect on total logistics costs or help to coordinate and complete logistics tasks. (Lai & Cheng, 2009, p. 39)

Customer service

The management of the logistics flow projects into quality of the service. When the flow is effective, the goods are delivered to the customer at the right time, in perfect conditions and at the lowest possible cost. Logistics processes become effective when the company is able to create and maintain customer satisfaction and long term relationships. (Lai & Cheng, 2009, p. 39)

Customer service might be also described by “seven 7 R’s rule” which says that excellent customer service and added value are achieved by having the right product, in the right conditions, in the right quality, at the right time, at the right place, at the right cost and for the right customer. When any of these seven R’s breaks, the flow is interrupted and the result is poor customer satisfaction. (Bloomberg, et al., 2002, p. 65)

Order processing

All activities related to information about sales-order. Suppliers and companies share this information (mostly information involving time) to plan following activities connected to sales order – for instance production, financial estimation or market analysis. In these days of high competition, the greatest challenge for companies is to shorten the time when customer places the order to delivery of goods as much as possible. (Lai & Cheng, 2009, p. 40)

Same issue is explained in Bloomberg et al. (2002, p. 65) as an order cycle system. Departments within the company such as marketing, finance or accounting are included in this process. The order cycle system is created by four sub-processes: order transmittal, processing, preparations and shipment. There are many people involved in this cycle, and more people and order-handling means more money and more time. Reducing the order cycle time is the reason why companies should put more efforts in minimizing the number of people involved.

Inventory management

The level of inventory is usually based on predictions and forecasts, but due to the fact that they are not accurate all the time, companies are keeping stock to meet the demand when the pattern is changed. (Bloomberg, et al., 2002, p. 65)

The main idea of effective inventory management is to keep the level of stock as low as possible and to provide sufficient amount of products for customers at the same time. The effectivity and efficiency in inventory management will reflect in noticeable logistics-costs savings. (Lai & Cheng, 2009, p. 40)

Transportation

Transportation is the main linkage between all logistics activities within the logistics chain. It can be seen as a “glue” that sticks the whole system in one piece. (Bloomberg, et al., 2002, p. 66)

Transportation involves all different ways of moving goods within the supply chain. Effective transportation management selects and utilizes the best modes and routes. Outcomes of transportation management might increase the sales, profit or market share. (Lai & Cheng, 2009, p. 41)

2.1 Supply chain management

In recent years, logistics is considered as a framework of a much wider concept of Supply Chain Management (SCM). The basic assumption of a chain is that it connects two parts on the both ends together. As the definition of supply chain management says, the chain is not only direct linkage of two ends but rather a network of chains because in many cases there are multiple suppliers, customers or even suppliers’ suppliers in the system. This relationship is significantly different than traditional supply/buyer in the past. (Chrisopher, 2011, p. 3)

As said before, it is a chain and the chain is only as strong as its weakest link that is why each member of the supply chain depends upon each other. (Bloomberg, et al., 2002, p. 1)

The main role of SCM is to find a connection and co-ordination among other entities (i.e. customers, suppliers) through the entire network. The effective management of all relationships is based on mutual trust and cooperation in

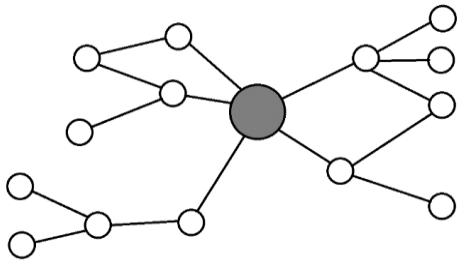

Figure 1 The supply chain network (Chrisopher, 2011, p. 3)

order to deliver better value to the customers and therefore reach higher profits. Figure 1 shows an example of a company located in the network of customers and suppliers. (Chrisopher, 2011, p. 3)

Lately, certain changes in the market can be recognized. According to latest research manufacturing companies are nowadays changing their approach from downstream SCM (driven by manufacturing companies) to more customer driven Demand Chain Management (DCM) which can enhance the responsiveness to customers' needs and bring new opportunities to companies. (Walters, 2008)

2.2 Warehouse management

Although the role of a warehouse has slightly changed in past few years, it is still considered as one of the major parts of the supply chain. Previous perception of a warehouse was a necessary evil and a cost centre. The changes in customers' demand have altered the perception of a modern warehouse and its operations. The view of a warehouse has moved from a direct linkage between two points of the supply chain to a significant node of a complex supply chain network. Current best-in-class warehouses can serve as a source of company's differentiating advantage, which increases profits and allows the growth of the entire company. Among the basic responsibilities of warehousing management are cost and inventory reductions, efficiency, accuracy and productivity improvements and the enhancement of the customer service at the same time. (Richards, 2014, p. 5)

Some might think the warehouse management is an operational day-to-day job, but companies should look at warehouse management on a strategic level. There are main aspects of business involved in warehousing operations such as production, products, suppliers and customers. With a strategic approach to a warehouse, there are some key questions to consider. By answering these strategic questions, the management of a company can make better decisions for future. These are examples of strategic questions for a warehouse. (Emmett, 2005, p. 6)

- Is there a need of a warehouse?
- Is the location appropriate?
- Is the labour force stable?
- Is the information visible enough?
- How fast is the response to customer order?

3 WAREHOUSES

The essential role of a warehouse is to balance fluctuations in demand and supply. However, modern warehouses are not only capable of storing goods. (Bloomberg, et al., 2002, p. 172)

3.1 Types of warehouses

Many different types of warehousing operations can be distinguished. The role of the warehouse vary within the supply chain. Among the operators of a warehouse, there can be raw materials suppliers, manufacturers, wholesalers or retailers. The owner of the warehouse can be either a company itself or it can be sub-contracted by a logistics provider. There are three main types of warehouses – raw materials storage, intermediate and storage of finished goods. (Richards, 2014, p. 7)

Raw materials

The warehouses of raw materials are mostly located as close as possible to the manufacturing sites to make sure the production is continuous. Typical materials stored in this kind of warehouse are raw materials – metals, plastics, or other components necessary for production. (Richards, 2014, p. 7)

Intermediate, customization, sub-assembly facilities

These warehouses are used for short-term storage of products in different phases of production. Companies can also use them for product customization such as special labelling or packaging (i.e. various languages), country specific or product bundling. (Richards, 2014, p. 7)

Finished goods

In order to minimize the risk of unavailability of goods, fluctuation in demand or dealing with seasonality, companies such as manufacturers, retailers and wholesalers use storage of finished goods as a buffer or safety stock. (Richards, 2014, p. 9)

There are also many other kinds of warehouse services for specific purposes. (Richards, 2014, p. 10)

- Consolidation centres and transit warehouses – the purpose of consolidation centres is to receive goods from various locations and sources and consolidate them for other onward shipment to the customers.
- Cross-dock – cross-dock centres are similar to consolidation centres, but the main difference is in time. In cross-dock the target is to despatch in the same day as delivery.
- Reverse logistics centres – in recent years the importance of e-retailing is increasing and companies have to face a great deal of returned products. The process of returning the product back to stock is called reversed logistics.
- Other – i.e. sortation centres, fulfilment centres, public sector warehousing). (Richards, 2014, p. 11)

3.2 The purpose of stock

The perception of a stock can be two sided. First, the tangible part is a physical thing stored in real-life building of a company. On the other hand, stock can be intangible in a form of information stored in company's records. (Muller, 2011, p. 1)

Although lately the trend in warehousing has been to keep the stock levels to minimum, it is almost impossible to achieve supply chain completely without stock. The reason for that is unpredictability of all events occurring on the market for example customer demand, production constraints or weather conditions. Companies keep their stock because of the following reasons. (Richards, 2014, p. 12)

- Uncertain/erratic demand – The demand for products is not the same all the time – it is fluctuating because of various reasons (weather) and organization have to be prepared for this unpredictable behaviour.
- Transport/shipping costs – Lower costs per unit can be achieved by moving product in large quantities. The trade-off between these costs can justify larger shipments. With larger quantities of transport there are requirements for larger storage linked.
- Bulk buying discounts – Purchase of large quantities brings the opportunity to have an attractive discount. The procurement should be confident about the demand for that products because additional storage means increased costs.
- Manufacturer-customer distance
- Production shutdowns – There are many reasons for production shutdowns and companies have to keep safety stock to cover them. The reasons are for example machine maintenance or vacations.
- High seasonality
- Spare parts storage – to ensure the continuous production, it is necessary to keep certain amount of spare parts in the stock.
- Work-in-progress storage – Especially during production of extensive machines, companies can face problems with delivery of particular part of the machine and they need to store the unfinished product.

(Richards, 2014, p. 14)

3.3 Warehouse operations

All operations within a warehouse are generally labour demanding. The general law for warehouse operations is that the handling costs are higher when the handling unit is smaller. It means for example that if 5 000 matchboxes are handled separately, much more labour and effort have to be used. Handling of

Figure 2 Material flow within a warehouse (Bartholdi & Hackman, 2008, p. 22)

stacked matchboxes on a pallet would be significantly easier with less costs. Although warehouses have various purposes and some operations may differ, the basic operations with material flow are the same for all of them. The process with physical material is illustrated in Figure 2 below. The processes can be divided as follows. (Bartholdi & Hackman, 2008, p. 21)

- Inbound – receiving, put-away
- Outbound – order-picking, checking, packing, shipping

There are certain rules for warehouse operations that help to make operations more efficient. In general, the flow of goods should be continuous and double-handling should be avoided. With unnecessary double-handling the costs are considerably increasing. In order to achieve good visibility of material movement inside the warehouse, all products should be scanned between each process steps. (Bartholdi & Hackman, 2008, p. 22)

Receiving – Receiving process begins with arrival of goods into warehouse. A receipt should be made out and the goods must be unloaded and scanned into system. Later, the inspection should be made to detect possible damages, incorrect amounts or other problems. (Bartholdi & Hackman, 2008, p. 22)

Put-away – The First step is to determine the location of storage for goods. The location is important for further quicker response when picking the goods. After the location is chosen, the goods can be put-away and again, the location of goods should be scanned. (Bartholdi & Hackman, 2008, p. 23)

Order-picking – The most labour-intensive activity. Before actual picking, the warehouse has to check availability of the goods, produce the documentation and make the schedule for picking and shipping. Great deal of order-picking process is carried out by Warehouse Management System, but even though the order-picking costs accounts for approximately 55% of operational costs. (Bartholdi & Hackman, 2008, p. 25)

Checking and packing – The proper time to check the goods is during packaging because all pieces are being handled. The order accuracy is a very important parameter for customer satisfaction. When the order is incomplete or inaccurate, the customer is not satisfied or is even angry. Moreover, the goods are returning to the warehouse which increases the costs. (Bartholdi & Hackman, 2008, p. 26)

Shipping – When the order is complete and ready for shipping, it is scanned to the system and shipped to the customer. It is good to ship to one customer as many goods as possible in one part. It is less cost-demanding, and most customers prefer it. (Bartholdi & Hackman, 2008, p. 27)

Reversed logistics – The process of dealing with returned or wrong items. These items can be restored (repaired, reused) or disposed of. In recent years, this process has increased its importance in warehouse operations. The disposal of items must be done with consideration of environmental issues, otherwise the company can face fines or legal problems. (Richards, 2014, p. 177)

3.4 Warehousing costs

Typically, there are two main categories of costs – variable and fixed. The variable costs are related to some activity – the variable costs are growing with increased activity. While fixed costs, as the name says, are constant despite of any activity. For warehousing, fixed and variable costs include the following: (Emmett, 2005, p. 174)

Fixed costs:

- Rent of the warehouse
- Energy (electricity, heat, gas). Though energy is related to activity, in many cases these can be viewed as fixed because the cost is relatively low compared to others. In special cases, when energy accounts for larger part of total costs, for instance food warehouses, it can be considered as variable.
- Building/assets insurance

- Depreciation
- Wages (basic)

Variable costs:

- Wages (overtimes)
- Maintenance
- Operational costs of equipment
- Goods/products insurance

The total costs are calculated by putting together fixed and variable costs. For warehouse purposes, costs can be divided into 3 categories: labour, space and equipment. In common warehouse the labour costs account for 60%, space for 25% and equipment for 15% of the total costs. (Emmett, 2005, p. 175)

The cost systems in different companies may vary. For example, overhead costs are difficult to allocate to a particular activity. Another way to categorize warehousing costs is to divide them into four categories. (Speh, Ph.D. , 2009)

- Handling – all costs related to goods movement such as receiving, pu-away, picking or direct labour.
- Storage – costs associated with items stored. It includes for example rent of the facility or energy.
- Operational administration – expenses for IT systems, supervision, taxes or insurances.
- General administrative expenses – overhead costs not directly related to warehouse. The cost allocation here is a matter of judgement, but they can contain general management costs, main office costs and many others.

4 METHODS FOR WAREHOUSE OPTIMIZATION

There are many ways how to optimize a warehouse. For purpose of this thesis, the following methods were considered.

4.1 Differentiation of stock – ABC analysis

ABC analysis is a widely used tool in logistics. The core of this analysis is based on Pareto law 80/20. It says that 80 per cent of effects are caused by 20 percent of origins. The rate 80:20 can vary in different situations, but the rule is applicable to many activities across various fields. The following examples should help to understand this rule. (Richards, 2014, p. 80)

- 80% of inventory value is made by 20% of products
- 80% of problems are caused by 20% of employees
- 80% of sales are made by 20% of customers

For example, in terms of sales the analysis classifies items into 3 categories – A, B, C, and based on this classification it is possible to make better decisions – where to put most of focus and effort. The most important category for business is A – 20% of items making 80% of sales. Category B is made by 35% of items creating 15% of sales and the last C category 45% of items creating only 5% of sales. (Richards, 2014, p. 80)

ABC analysis can be used when designing a warehouse layout. The idea here is to put the products with highest sales (category A) to the front of the warehouse to make the handling easier. (Richards, 2014, p. 81)

The ABC analysis can be even performed in more detail and divide inventory into 5 categories with additional categories D and E. The recommended ratio for inventory item categories is 5:10:18:27:40. (Palevich, 2012, p. 147)

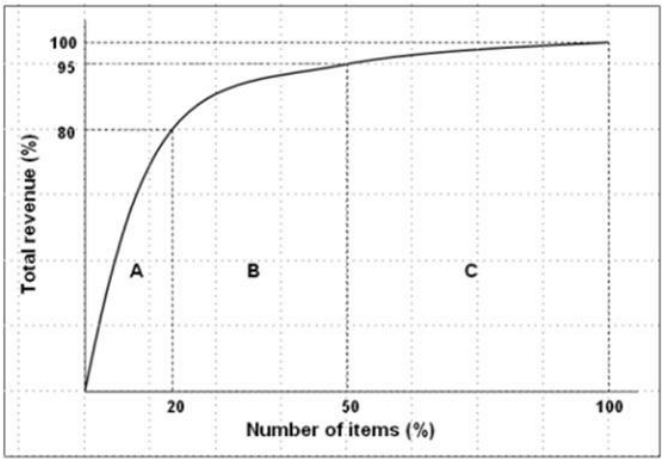

Figure 3 ABC analysis of stock items

Available at: http://bit.ly/1GcY0vx [Accessed: 17 April 2015].

Figure 3 explains the principle of ABC analysis. The graph shows how items are categorized: A (20% items accounts for 80% of total revenue), B (30% items accounts for 15% of total revenue) and C (50% items accounts only for 5% of total revenue)

4.2 Warehouse layout

Companies can achieve more storage by wise planning of warehouse layout and efficient utilization of space. The design of warehouse should be considered when building a completely new warehouse, re-designing existing one or moving to a different place. Although every company has different demands and requirements, there are some essentials that need to be followed. These are the factors that company should take into account when designing a warehouse. (Richards, 2014, p. 204)

- Data collection – By collecting all necessary data related to warehouse, company can decide and plan the requirements of warehouse. The basic information are stored products, sizes, number of items, but there are also some additional information for instance number of suppliers, average intake of products or average order size.
- Future plans of the company – Warehouse design also depends on 5 to 10 years future visions of the company.

- Cubic capacity – Warehouse is not only the floor thus the whole cubic space should be utilized. Better cubic space utilization requires proper handling equipment.
- Health and safety of employees – Company should be focused all the time on safety and health of its employees (proper lights, air conditioning or ergonomic equipment)
- Standardized packaging – In order to make storage more efficient it is required to standardize the packaging either for storage or movement. (Richards, 2014, p. 205)

4.2.1 Location system

When the proper layout is developed, also location systems need to be considered. It is difficult to remember where all items are stored. In order to create a location system 4 steps should be done. (Jessop & Morrison, 1994, p. 215)

1. Divide the warehouse into sections and assign a unique symbol (a letter or a number)
2. Assign number to each stack from one end to the other
3. Assign number to each bay of racking in the same manner
4. Identify each bin by a number

By assigning these numbers, each location is exactly specified with a unique address. An example of this address is B.23.2.15 which means that the particular item is located in section B, stack 23, bay 2 and bin number 15. This location should be recorded in the warehouse management system to allow warehouse employee to easily find the specific item in a complicated warehouse environment. (Jessop & Morrison, 1994, p. 215)

4.2.2 Material flow

Related to warehouse layout, the material flow should be considered. There are certain rules to plan an efficient material flow. For material flow, three main aspects are important – product, quantity and routing. Product specifies what is stored, basically the physical attributes of products such as dimensions, risks of damaging or its value. Quantity means how many of products will be

stored. Linked to quantity of products is number of handling. Routing determines the actual product flow within the warehouse layout. For proper routing system, all operations with products must be regarded. (Hales, 2006, p. 35)

Effective material flow will be achieved when the distance for traveling across warehouse is minimized. The material flow belongs to the largest contributors of the operational costs because in most cases, this activity requires a great deal of labour and equipment. (Hales, 2006, p. 36)

4.3 Quality systems

Nowadays, the quality systems are becoming more important for organization's leadership for successful management of the company. These systems also affect warehousing operations. The most common quality standards are the following: (Aminga, 2015, p. 4)

- ISO 9000 – Standards of quality management principles focused on customer needs and long-term improvement in organization's performance.
- ISO 14000 – Environmental standards helping organizations to minimize the negative impacts of their activities on the environment
- ISO 50001 – Energy management systems
- EFQM Excellence Model (Richards, 2014, p. 56)

4.3.1 ISO 9000

The main set of quality standard is nowadays ISO 9000. The basic idea of quality is described by 8 principles which should be met every time to ensure good profitability in the long term. The principles are stated below. (ISO Central Secretariat, 2012)

1. Customer focus
2. Leadership
3. Involvement of people
4. Process approach
5. System approach to management
6. Continual improvement

7. Factual approach to decision making
8. Mutually beneficial supplier relationships

Advantages of ISO 9000 principles

Implementing quality systems is optional for everyone and it is only a matter of judgement, but each of these principles has many advantages for the business. By applying these principles in day-to-day activities, company can achieve more flexibility and faster response to market changes, thus they can increase profits and market share. Key benefit is better customer satisfaction because company should focus all the time on real customer needs. Satisfied customers are also loyal and bring continuous income to the company. The purpose of involvement of people is to motivate employees, and enhance their contribution to the company. With process approach, company can lower their costs and make their activities more effective. (ISO Central Secretariat, 2012)

4.3.2 EFQM Excellence Model

EFQM (European Foundation for Quality Management) provides another option for companies, to enhance growth and be prepared for challenges on the market. The model provides a framework to management of a company with a main goal – to become more competitive and to ensure continuous improvement. Although the EFQM model is focused on simplicity, the implementation does not have to be unsuccessful all the time. (Dutt, et al., 2012)

The main idea of the framework is based on TQM – Total Quality Management. It assumes that company can achieve continuous improvement by self-assessment. The model consists of two groups of criteria: enablers and results. (Gašparík & Gašparíková, 2013)

- Enablers – what company have
  - Leadership
  - Strategy and Policy
  - People
  - Partnerships and resources
  - Processes, products and services

- Results – what they can achieve
  - Key results
  - People results
  - Customers results
  - Society results

4.3.3 Continuous improvement

There are different tools based on different methodologies that can be used to ensure continuous improvement of an organization. For example RADAR matrix or PDCA. (Sokovic, et al., 2010)

RADAR

RADAR – Results, Approach, Deploy, Assess and Refine. This tool is included in EFQM Excellence Model and it emphasises the performance of a company with structured approach. First, the results should be defined to know what to achieve. Then, the approaches for delivery are suggested and deployed. Finally, the improvement is assessed and refined if the intended results were achieved. (Sokovic, et al., 2010)

Deming cycle – PDCA

PDCA is another how to improve quality and ensure continuous improvement of the company. The basic idea is to Plan, Do, Check and Act. Plan means collecting data and identifying the problems and suggesting improvements. By doing, the improvements are implemented. Later, the results must be checked

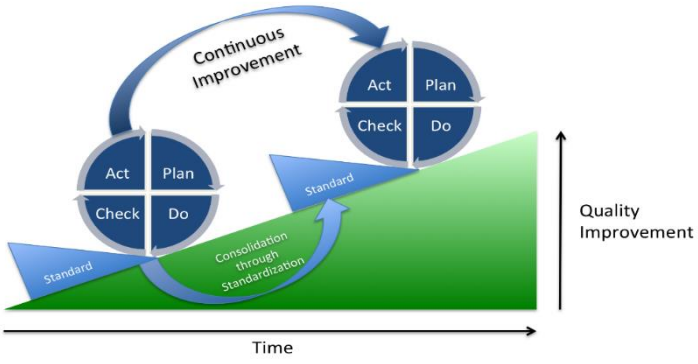

Figure 4 PDCA cycle of continuous improvement.
Available at: http://bit.ly/1yK6url [Accessed: 10 April]

to see that everything goes according to the plan. At the last stage act, the implemented solutions are recognized as a standard, and the cycle returns to the beginning stage. The idea is well illustrated in Figure 4. (Charantimath, 2009, p. 48)

4.4 Information systems – Warehouse management system (WMS)

Warehouse Management System is a vital component of efficient modern warehouse. It is a software with primary objective to control the movement of materials, storage levels, and other related processes, i.e. shipping, receiving or picking. Usually, the WMS is an integrated module in ERP (Enterprise Resource Planning) system of the company. Among all functions of WMS, the following are the most essential: order fulfilment – including the whole process with order transaction, inventory management and warehouse productivity. WMS also provides other important functions such as monitoring, transportation performance, scalability, postponement or cross-docking. (Palevich, 2012, p. 27)

The need for the warehouse management system grows with increasing number of stored items. The companies should consider implementing a WMS when the following situations occur: the number of the items in the actual inventory and in the book inventory differs, demanded items are often out-of-stock, items losses, many customer complains, customers' orders are increasing, number of items are increasing or the responses to customer orders are slow. (Mulcahy & Sydow, 2008, p. 4)

Avoiding these problems is the key benefit of using WMS, but there are other advantages. Implementing WMS can enhance visibility and traceability of stock and total productivity will increase. WMS can automate the processes which can reduce labour costs or improve accuracy of orders, thus increase customer satisfaction. Moreover, by all above mentioned benefits, the total costs should be substantially decreased. The following figure shows the benefits of appropriate information system. (Richards, 2014, p. 189)

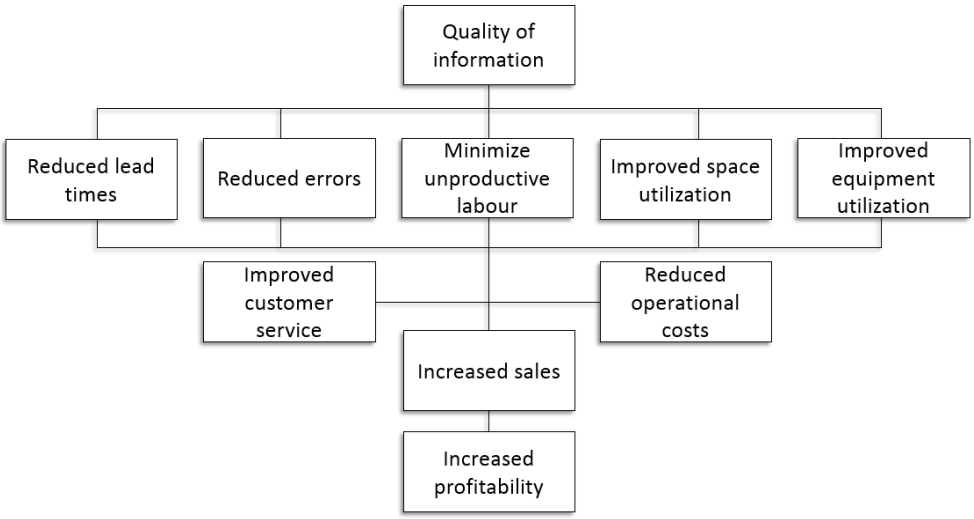

Figure 5 Advantages of information systems
(Richards, 2014, p. 190)

5 COMPANY CHARACTERISTICS

Company BEDNAR FMT is a farming machinery manufacturer from Czech Republic. They sell (export) their products around the whole world.

5.1 Company information

In 1997, a company Strom Export was founded with an objectives to export farming machinery abroad. Three years later the company started own manufacturing operations and produced their first own disc cultivator. In 2005, the company made significant investment in their own manufacturing subsidiary which is located in Rychnov nad Knežnou. Nowadays, the subsidiary has grown with additional raw materials warehouse, spare parts warehouse, new manufacturing plant and powder coating plant. In 2013, the name of the company changed to BEDNAR FMT. (BEDNAR FMT, 2015)

The company manufactures three main categories of farming machinery – tillage, seeding and fertilizing and slashing. The development of products is oriented on needs of farmers, and also some farming companies take part in the development process. The manufacturing process is still being improved and the company has put substantial capital for new investments. The main objective is to increase efficiency and capacity of production because the company has built a well-established brand on the market, and the demand for their products is increasing. With increasing sales, there is also a direct relation with warehousing demand. (BEDNAR FMT, 2015)

5.2 Information System

BEDNAR FMT is using an information system Helios Green for all processes within the company. Helios Green is an ERP solution for enterprises developed by Helios Software – company from Czech Republic. This solution provides complex functions for all business areas. The systems is scalable so each solution can be tailored to needs of particular organization. One of the modules, Logistics and Stocks, includes all necessary WMS functions. (Helios, 2015)

- Stock registration, stock evaluation (FIFO, mean price), tracking system
- Flow of all documents for the logistics process (inquiry, order, acceptance, reservation or issue
- Return products management
- Many pricing options
- Stock and balancing for each warehouse
- Statistics methods
- EDI standards

5.3 Manufacturing warehouses

The company possesses multiple warehouses. Next to the manufacturing plant, there is a raw materials warehouse, finished goods and spare parts warehouse. The company has also two smaller warehouses for marketing purposes. Nowadays, the marketing warehouses are causing major problems to the company, and it is necessary to make some improvements in this respect.

Raw materials warehouse

This warehouse is located in the area of the manufacturing plant. The warehouse is a large hall directly connected to the manufacturing hall. For material movement, it is equipped with overhead cranes with maximum load of 10 000 kg. There are 6 pallets racks operated with a pallet forklift truck. Each locations are labelled with unique code for stock record (warehouse management). All items are stored in Helios Green which makes the system sufficiently visible and easy to orient in. (Strouhalka, 2014)

Finished goods and customization warehouses

The largest area for storage is dedicated for finished goods. The purpose is to store finished products until they are being delivered to the customers. One of the storage areas is located in front of the manufacturing plant, another on the large parking space next to it and the third one in front of the spare parts warehouse in Doudleby nad Orlicí which is 10 km away from the manufacturing site. In these storage places, the final adjustments and preparations of products are being made such as equipping with country specific items (user manuals, warranty information) or preparations for transport. The final products can exceed width of 18 m and length of 8 m and there can be tens of products waiting for transport at the same time. In spite of these facts, the area for storage is quite extensive. In Rychnov, there is a possibility to store products within 2 500 m^2 (500 m^2 in front of the plant and 2000 m^2 on the parking space) and in Doudleby the area is even 25 000 m^2. The items in Helios Green are only categorized by place of storage (Rychnov – place in front of the plant, Rychnov – parking space, Doudleby), thus it is not possible to know where exactly (which row) the machine is located, but the machines are large

enough so there is no need to store this information in WMS. (Strouhalka, 2014)

Spare parts warehouse

This warehouse serves as a storage and issuing place of spare parts for the machines. The average number of items is 60 000. There are 22 pallet racks, 29 shelves and outdoor storage. The layout of this warehouse can be seen in Appendix 3. Each pallet rack is 3 m wide and 1 m deep, and can store 3 pallets next to each other. The height is 4 m and it is divided with joists into 4 storage levels. Shelves are 1.5 m wide, 0.5 m deep and 2.3 m high. They are divided into 6 storage levels. Outdoor storage is used for large spare parts. It is surrounded by a secured fence and covered with sheet metal roof. All storage locations are labelled with a unique code, and the items are stored in the WMS. The average inventory level is around 75%, so there are several racks and shelves empty. The company is still increasing the production and sales, so the demand for spare parts will also be higher in the future. (Novák, 2014)

5.4 Marketing warehouses

There are 2 warehouses for marketing activities of the company. One is located in the main office building in Prague and the other warehouse is 10 km away in Brandýs nad Labem. The main items stored in these warehouses are the following:

- Machine brochures – there are several kinds of brochures that the company uses. Those are large and small catalogues of machines and also each machine has its brochure in 10 different languages. Altogether, the company uses approximately 180 different brochures.
- Promotional products – products with brand logo, mostly in colours of the company (black and yellow) used for brand image promotion. These items are given away or sold to customers or other people during events such as trade fairs. Among these items, there are for instance jackets, hats, t-shirts, pens, plastic bags and etc. Nowadays there are approximately 40 categories of promotional products. All

- Exhibitions materials – items used for trade fairs and exhibitions such as aluminium trusses, flag poles, tents, stands or decorations. In last years, the company increased participation on exhibitions or fairs that is why the material amount is growing.

Marketing warehouse in main office (Vinor)

Vinoř is a room located in the basement of the building with dimensions of 6 x 3 metres. The purpose of this room is to cover unexpected demand for brochures or promotional products by sales representatives. Going every time to the main marketing warehouse only for several brochures would waste time and money. There are two shelves in the room located opposite each other, they are 4.5 m long, 0.5 m deep and 2.3 m high. The shelves are divided into 18 compartments.

Marketing warehouse in Brandýs nad Labem (Brandys)

The purpose of Brandys warehouse is to store all promotional products and exhibition materials. The warehouse is rented and the company has been using it since 2008. The dimension are 20 x 20 (400 m^2 of storage space) metres and 10 m of height. It is equipped with a two-sided shelf (12 m long, 2.5 high, 2 m deep), one-sided shelve (8 m long, 2.5 m high, 1 m deep) and a pallet rack (8 m long, 4 m high, 1 m deep). Upon the first shelve, there are mostly brochures and promotional products stored, and the second shelve is dedicated for spare parts exhibition material. The rest of the warehouse is used for storage of exhibition material. The warehouse is equipped with an electric forklift stacker with a reach of 5 m. The figure below shows the layout of Brandys warehouse. Usually, there are many unorganized boxes, pallets and other items around the warehouse without dedicated location. For material transport, the company uses a small lorry Mercedes-Benz Sprinter with additional box.

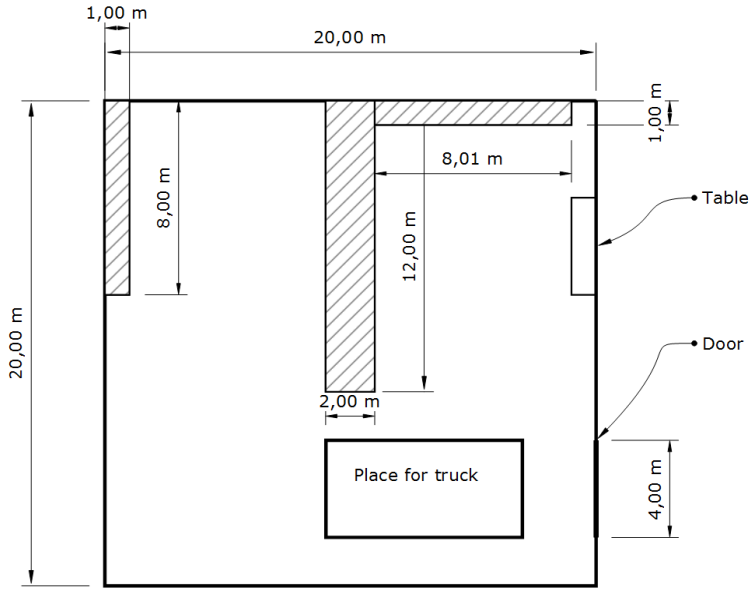

Figure 6 Current Brandys warehouse layout.
(Created with Sketchup layouts software)

Warehouse management system

A few years ago, the warehouse employees (marketing staff) only used basic paper records of the stock level of each item. This approach caused many inconveniences because it was really easy to make a calculation mistake, and the paper was even lost several times. Nowadays, there is still no warehouse management system (Helios Green) for marketing warehouses. The marketing department is using only a basic excel sheet with formulas. By using formulas they achieved fewer mistakes. The file is stored on a backed-up hard drive so it cannot be lost, and only authorized people can access it. Although there is sufficient free space in the warehouse and the possibility of internet connection, the company still has not installed a computer into the warehouse, and the employees can input the data into the file after they come back to the office. This again brings up the same problem as in the paper record – careless mistakes of employees when the real number of items does not correspond with the number in the file.

The minimum stock level is set in the excel file by conditional formatting. For example, when the level of particular machine brochure drops below certain number, the cell will turn red.

There are no stable operators in the warehouse who would be at the place for the whole shift. The operations in the warehouse are carried out mostly by part time employees of the marketing department. Since they are part time employees, they cannot cover all operations needed within the warehouse. Moreover, it is not their only responsibility and they often postpone tasks or even transfer them to a different person (also part time employee).

5.5 Conclusion of current state

The warehouse analysis revealed that manufacturing warehouses comply with management's expectations and there are no major constraints in operations. The situation is opposite in marketing warehouses. There are multiple drawbacks in these warehouses mostly caused by increasing amount of stock level and demand for stored items.

The key problems within marketing warehouses:

- Layout of warehouses – A few years ago the layout of warehouses was sufficient but with increased number of items it is starting to be substantially inconvenient. Moreover, the company wants to extend the number of stored items. The Brandys warehouse is not using the space in the hall efficiently (especially height) and also the layout of Vinor storage room could be more room-efficient.
- Inventory management – probably the most crucial problem. At the moment, nobody knows exact stock levels and the current records (excel sheet) are inaccurate.
- Minimum level control – although the file provides some basic minimum level control, the following proposal for improvement will also take this matter into account.
- Receipt/issue – There is completely no system of Receipt/issue, thus is impossible to trace or control who issued or received the particular product.
- Cost calculation – For better total cost calculations, it would be convenient to allocate also overhead costs for marketing warehouses. So far

the company allocates to the warehouse only direct costs (rent and purchases). This cost calculation could also help to set a correct price for the products that are sold to the customers.

Considering all these mentioned facts it is necessary to make several improvements to warehouse processes to build a sustainable environment for the future.

6 PROPOSAL FOR IMPROVEMENT

The previous chapter described and analyse main drawbacks of marketing warehouses of BEDNAR FMT. The proposals for improvement are discussed in the following chapter.

6.1 Vinor warehouse

Although the Vinor warehouse is only a small room in the basement of the office and the problems are minor compared to Brandys warehouse, there are still some issues that can be improved. After discussion with marketing manager we suggested improvements.

6.1.1 Layout

Considering the fact that this warehouse is only a single room, the layout is satisfactory. There is a possibility to increase the capacity of the storage space by 50%. The company can invest small amount of money into additional shelve. The aisle is still wide enough for all material handling. The mar-

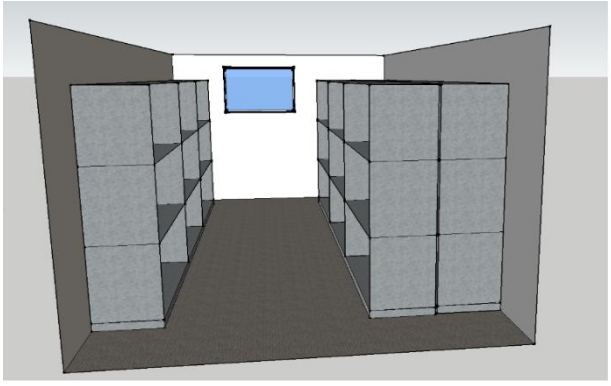

Figure 7 Vinor warehouse with additional shelve (Created with Sketchup software)

keting department could use this additional space to store more machine brochures and also add some promotional products because at this time the range of brochures is not sufficient. Figure 7 illustrates layout improvement in Vinor warehouse.

6.1.2 Import of the warehouse items to Helios Green

The major problem of Vinor is lack of proper stock management. The import of all items into Helios system will provide better visibility of stock items. The creation of a new warehouse in the system is an easy task. The marketing manager has to raise a ticket in the system, and the IT department will create a new location in the system within few days. The process with importing items has 4 main steps:

1. Preparing the warehouse – as seen in the figure 7 the shelves are divided into 18 sections. Each of these will be labelled with address. As there are not many sections, the address can consist only of a single number from 1 to 18. There is no need for installing a new computer to this room, because it is located close to office rooms and employees can take their laptop with them for making some operations (e.g. receiving or issuing) there.
2. Stock-taking and data input – to ensure there will be correct numbers in the WMS, marketing department has to perform a stock-taking. After calculating all items, the data needs to be input into Helios Green by person with previous experience with this software.
3. Receiving of the goods – because at this point the warehouse would be empty, all the items need to be received as new goods.
4. Training of employees – necessary training for employees who are involved with this warehouse needs to be done. The training should be in form of few-hour intensive course and mandatory for everyone.

6.2 Brandys warehouse

For Brandys warehouse, there are 2 possible options for optimizing the processes. During one meeting an idea was raised – moving all promotional products and machines brochures to spare part warehouse which is not fully used. The second option is reorganization of current warehouse and improvement of its processes.

Option 1 – moving promotional products and machine brochures

As said in previous chapter, the spare parts warehouse in Rychnov is not fully used – there is still 25% of free space left. That would be enough for storing all promotional products. This option would be a kind of outsourcing when marketing department pays a service fee to spare parts divisions from their budget.

Option 2 – reorganization of Brandys warehouse

The second option considers total reorganization of current Brandys warehouse. This means new layout, new equipment, implementing of Helios Green systems and most probably hiring a full-time employee for taking care of the warehouse and related operations.

Pros and cons are summed up in the following table:

Table 1 Comparison of proposed solutions

Option 1		Option 2	
Pros	**Cons**	**Pros**	**Cons**
Well-established processes	Service fee	Close distance of the warehouse (10 km)	More labour demanding for marketing departmant
Better cost allocation	Longer delivery time	Higher flexibility	Initial investment
No investments	More labour demanding for spare parts departmant	Warehouse capacity	
Better distribution		Helios Green training	
Less labour demanding for marketing department			

As seen in Table 1, option 1 provides same number of advantages as option 2 but more disadvantages. A longer delivery time is mentioned, because the spare parts warehouse is located approximately 200 km from the main office.

The demand for promotional products and brochures typically occurs among sales representatives working in Vinor office. That is why the marketing department can react faster for this demand in case of option 2. The service fee is 300€/month, thus it is not a large cost burden. Although the greatest advantage of option 1 are well-established processes, by implementing Helios Green system the same effect can be achieved also in Brandys. All employees should be familiar with necessary operations in the systems because the company will provide the training for Vinor warehouse as well.

7 BRANDYS WAREHOUSE IMPROVEMENTS

After considering all given facts, **option 2** seems to be appropriate. It provides more options in the long term.

7.1 Layout

At the moment, the warehouse space is not efficiently used, and a new warehouse layout needs to be developed. In order to develop a new warehouse layout some information needs be considered. The items in the warehouse are from small promotional products (pens, caps, etc.) up to exhibition materials with large dimensions and heavy weights for example extendable flag poles (3 m length), aluminium trusses (4 m length) or large illuminated banners. Future plan of the company is to keep on increasing marketing activities. Although the warehouse is 10 high and the current racking is 2.5 m and 4 m high, new racking can be up to 4 m because of the maximum reach of fork-lift stacker. The warehouse will be equipped with closable plastic boxes for promotional products to secure them against humidity. The boxes will be unitary to make the storage space efficient. The new layout can been seen in Figure 9.

7.2 Location system

In order to make the process of finding items in the storage easier, the location system will be developed. Each place will be identified by the unique address with section, stack, bay and bin number, each separated with a dot. The sections are from A to E according to Figure 9.

- Section A, 6 stacks, 4 bays – promotional products
- Section B, 4 stacks, 4 bays – exhibition materials
- Section C, 4 stacks, 4 bays – machine brochures
- Section D, 2 stacks, 4 bays – bulks, pallets, spare parts
- Section E, 8 stacks, 1 bay – large exhibition materials

All addresses will be stored and assigned to each item in Helios Green. An example of an address is C.3.1.14

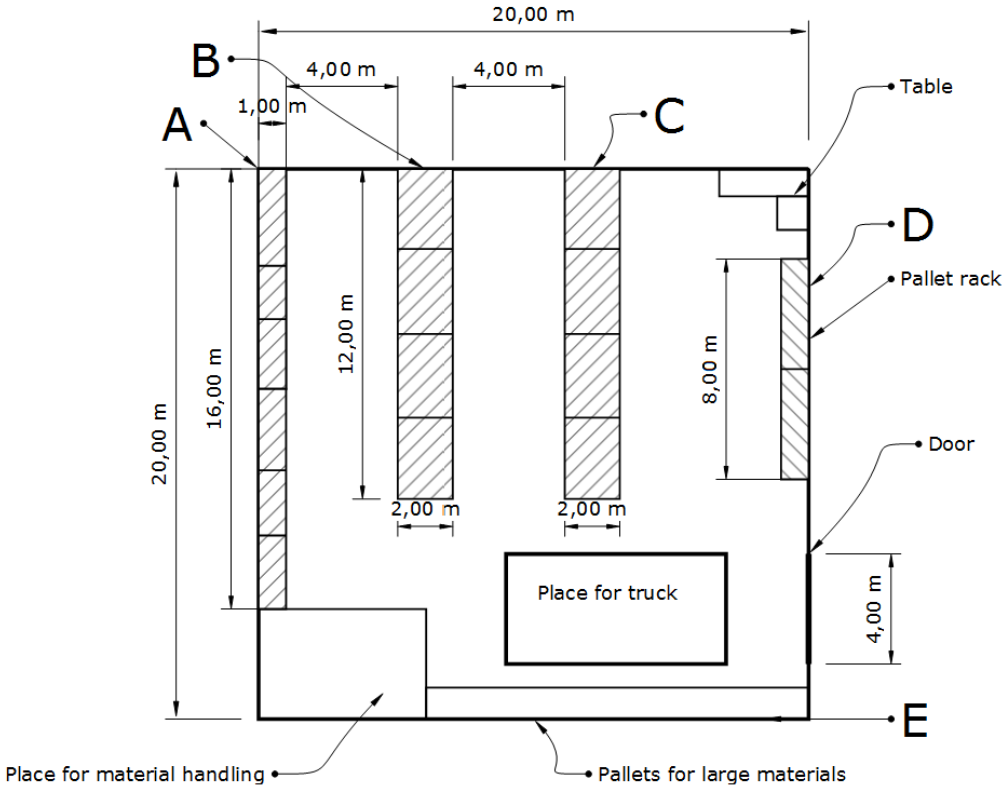

Figure 9 New layout of Brandys warehouse, including sections
(Created with Sketchup software)

7.3 ABC analysis

ABC analysis (different A, B, C than in location system above) can be performed based on raw data from old excel sheet. This information provides the approximate levels of stock for last year. The analysis makes sense for brochures and promotional products. The items will be categorized based on average monthly handling of the item. Items will be organized according to results of the analysis. The main purpose is to make handling of products easier and faster which should increase efficiency. Category A will be located in the

most convenient place for handling. In this case it is middle bay of shelving. The promotional products and brochures are not heavy, thus this location seems to be appropriate. The locations of all 3 categories can be seen in Appendix 2.

Unfortunately, at the moment the necessary data is not available and ABC analysis cannot be finished.

7.4 New equipment

The warehouse needs to be equipped with a new computer with access to intranet, printer and a wireless barcode scanner.

New shelves should be bought for extending the storage space. For the layout shown above, the following shelves are needed:

- Double-sided shelve 12 m long, 2.5 high
- Shelve 8 m long, 2.5 m high

7.5 Helios Green implementation

Same steps as in Vinor warehouse should be performed.

1. Preparing the warehouse – labelling locations with addresses and barcodes
2. Stock-taking and data input
3. Receiving of the goods
4. Training of employees (identical with previous one)

7.6 Other improvements

New employee

In order to ensure all processes within the warehouse are performed correctly, a new employee for position of marketing warehouse manager should be

hired. The main responsibilities would be receiving and issuing goods and taking care about operations. This person would be also responsible for marketing part-time employees.

Quality system

At this point, company has already implemented quality systems to the most of their processes, but marketing warehouses are not part of it. By following principles of ISO 9000 (not only for warehouse processes), marketing of BEDNAR FMT can become more effective and the company can gain competitive advantage on the market.

PDCA

All improvements proposed in this study should be performed in the manner of PDCA. After applying all changes to marketing warehouses, the system should be evaluated on a regular basis, if the initial objectives were accomplished. When the new system is stabilized and evaluated, with an idea of continuous improvement, other changes will be made to make the system even better.

7.7 Cost calculation

The following table calculates all initial invesmets proposed in this chapter. The prices are approximate and an exchange rate from EUR to CZK (1 € = 28 CZK) was used. The prices do not include VAT, and also there are

Table 4 Investment calculation.
Prices taken from: http://heureka.cz, http://profiregaly.cz/online-kalkulatory.

Investment	
Item	**Price**
Pesonal computer	690 €
Printer	103 €
Barcode scanner	190 €
Double-sided shelve 12 m	1 379 €
Shelve 8 m	345 €
Total	2 707 €

not working hours for installation included, but most of the installation will be provided by marketing part-time employees.

The improvements made in warehouses should decrease costs, especially for handling. Because the operations will be more organized, and the reliability of warehouse services will improve. There will be fewer returns and less lost items, and the visibility of stored items will increase in general. By extending the Vinor warehouse, the employees will avoid many travels to Brandys warehouse.

Storage costs will be slightly increased due to new computer (energy and internet connection).

The benefits of optimization should be reflected in operational and administrative costs. With the new warehouse management system, the marketing department will avoid many administrative expenses.

8 CONCLUSION

The main objective of the thesis is to propose a way for improvement of warehouse in BEDNAR FMT, a manufacturing company with headquarters in Czech Republic. In order to accomplish this objective, the three main questions need to be answered – what is the current state of warehouse processes, what is causing the problems and how to improve the warehouse. The first chapters of the study provide theoretical foundations for empirical research. The logistics related topics are discussed such as approaches to effective logistics, supply chain management and warehouse management. The theoretical framework introduces methods for warehouse optimization such as ABC analysis, layout or location systems.

The empirical part contains warehouse analysis and recognises the main constrain of company’s warehouse operations that is marketing warehouses. The problems there are caused by expansion of the company which means more sales and marketing activities. Related to this expansion, the number of items in marketing warehouses is increasing. In this condition, the marketing department is unable to satisfy the demand of warehouse customers, mostly sales

representatives, for marketing related products. The operations are unorganized and lack any proper inventory management or warehouse management system, which causes problems.

The study suggests two options for improvement. The first one is to move promotional products to spare parts warehouse and facilitate the responsibilities for marketing department. The second option is to perform a complete reorganization of current warehouses. The second option serves better for purposes and future visions of the company. The proposal includes new warehouse layout, WMS implementation, developing a location system and a solution how to prioritize inventory items. All suggestions should be implemented in manner of continuous improvement.

In my opinion, the initial objectives were achieved. The study presents solutions for warehouse optimization, and the company can use this study for improving their warehouses. There are some improvements such an ABC analysis which could not be done because the necessary data were not provided. On the other hand, the thesis contains only basic improvements, and there is still much work to do and the warehouses need much more effort to become really efficient. Of course, the company is still growing and should stay focused all the time on improvements of their business, not only regarding warehousing.

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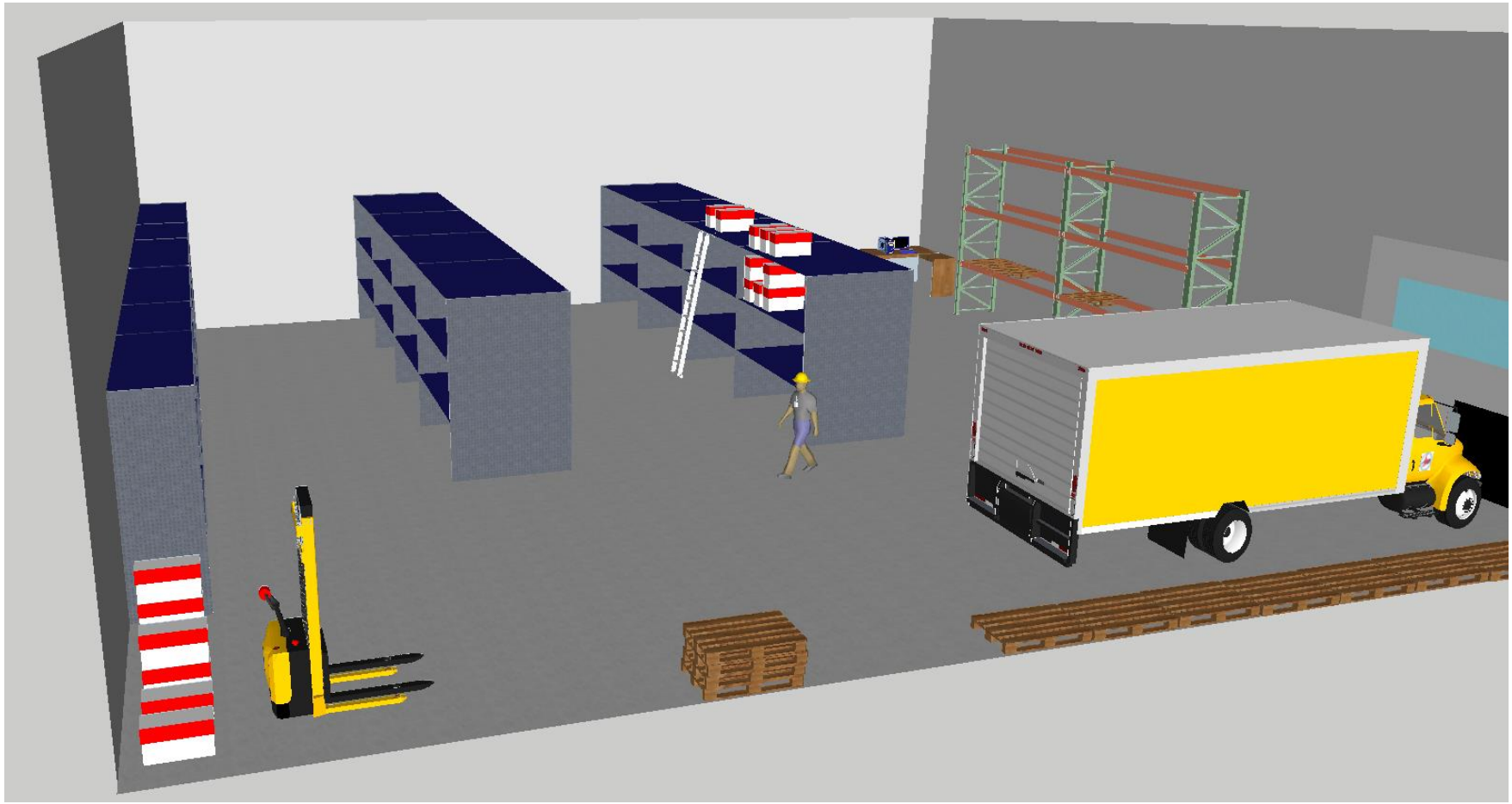
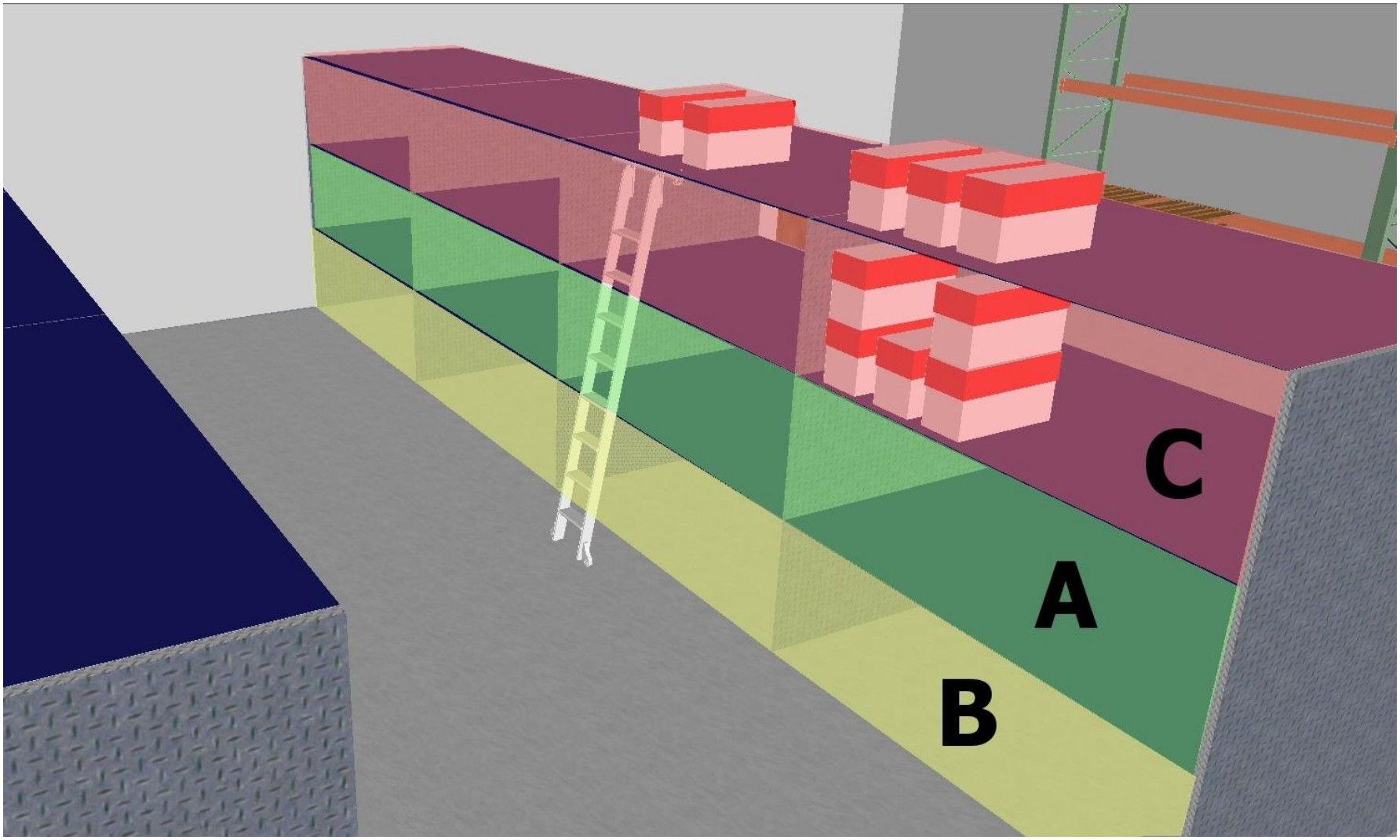
9.1 Figures

9.2 Tables

APPENDIX 1 3D model of new Brandys warehouse layout



APPENDIX 2 ABC categories location



APPENDIX 3 Schema of spare parts warehouse