

# Logistics Cost Calculation of Implementation Warehouse Management System: A Case Study

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**Abstract.** Warehouse management system can take full advantage of the resources and provide efficient warehousing services. The paper aims to show advantages and disadvantages of the warehouse management system in a chosen enterprise, which is focused on logistics services and transportation. The paper can bring new innovative approach for warehousing and presents how logistics enterprise can reduce logistics costs. This approach includes cost reduction of the establishment, operation and savings in the overall assessment of the implementation of the warehouse management system. The innovative warehouse management system will be demonstrated as the case study, which is classified as a qualitative scientific method, in the chosen logistics enterprise. The paper is based on the research of the world literature, analyses of the internal logistics processes, data and finally enterprise documents. The paper discovers costs related to personnel costs, handling equipment costs and costs for material identification. Implementation of the warehouse management system will reduce overall logistics costs of warehousing and extend the warehouse management system to other parts of the logistics chain.

## 1 Introduction

At present time companies try to minimize the costs of logistics. The concept of warehousing is very closely linked to logistics and distribution. Warehousing is within the logistics chain, one of the activities cannot be omitted. Warehousing addresses many crucial issues, inventory levels, ordering cycles, warehouse equipment and their spatial distribution, distribution of warehouse and inventory management. At high inventory levels incurred by companies fixed cost for each additional unit of inventory. Possession of inventory on hand may be necessary for the company due to preserve their source of supply. Warehousing is one of the most important parts of the entire logistics system. Warehousing is a link between manufacturers and customers, it provides storage for many products (e.g. raw materials, parts, semi-finished products, components and finished products). Warehouses allow to bridge space and time. Manufacturing inventories ensure optimal continuity of the production. Inventories of goods for ensuring smooth supply of the final customer.

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## 2 Theoretical background and methodology

With the constant technological advancement, the companies started to invest in new systems to support competitiveness in the market in which they operate. The trend of reducing the cost of warehousing is the maximum use of warehouse space, the minimum number of transfers, effective solution to the warehousing points or reducing the number of species of stored inventory. These costs are significant, if the free warehouse space on someone's rented, or if with a higher warehousing amount of enterprise must pay for additional rented premises, or energy, or heat. Warehouse managers are usually interested in providing high quality services to their customers at minimum cost. From a tactical, strategic and operational point of view, the main issues concern both the warehouse and the inventory management [1, 2].

Warehousing systems and material handling systems play a pivotal and critical role in the supply chain, and requirements for warehousing and handling operations have significantly increased in recent years [3].

Warehousing refers to activities associated with inventory management. These activities take place within the warehouse area, it is mainly the receipt of goods, purchase goods handling, picking, gathering and activities related to sorting [4, 5].

Warehouse management is not just a purchase, warehousing and transport within the warehouse; this is a more complex system that exceeds the physical boundaries of warehouses. Warehouse Management System (hereinafter WMS) is used to increase performance and warehousing for better management decisions for holding only strictly necessary supplies needed for the manufacturing process [6, 7]. WMS can take full advantage of the resources and provide efficient warehousing services provided by the plan, organize, control and coordination processes [8]. WMS is a necessary approach for every warehouse. An automated warehousing system provides less effort, more efficient, and reliable results compared to manual handled system. WMS is designed to help reduce costs through effective warehouse processes [9]. The tool known as WMS is a system that facilitates the handling operations and storage materials through defined parameters, but the deployment of this system need to go through steps that impact positively and negatively the company's various sectors [10].

The need for automating the warehouse arises from the fact that manual handling may cause human errors which may affect the warehouse utilization [11].

The case study, as one of the qualitative research methods, was chosen because it counts among the most frequently used methods within the research focused on the implementation of different management approaches into practice of organizations [12]. Case study is defined as an empirical survey of the current phenomenon in its natural environment, using multiple sources of evidence. Study cases are selected based on pre-defined conditions of the case [13, 14].

The aim of this paper is to show advantages and disadvantages of the warehouse management system in a chosen logistics service provider (Ewals Cargo Care), which is focused on logistics services and transportation. The paper will bring new innovative approach for warehousing and presents how the logistics enterprise can reduce logistics costs, mainly personnel costs. This is especially thanks to the implementation of warehouse management system. Data used in the case study is based on real logistics processes in logistics service provider. The paper discovers costs related to personnel costs, handling equipment costs and costs for material identification.

### 3 Case study: Warehouse management system in logistics service provider

The case study is focused on new innovative approach for warehousing and presents how logistics service provider (Ewals Cargo Care) can reduce logistics costs, thanks to the implementation of warehouse management system. Ewals Cargo Care (hereinafter ECC) is a transport and logistics company operating in the market for more than 110 years. For its customers, primarily in the automotive, electronics, paper and packaging industry, manufacturers and distributors of consumer electronics provides services both in the field of transport, as well as services related to warehousing and handling of goods [15].

The company's goal is always to find the optimal solution for shipping process on the way from supplier to customer, with the possibility of combining shipment, transshipment or use consolidation warehouses. ECC fully uses its years of experience, skills and knowledge to find and implemented for customers the most effective solution with the least impact on the environment [15].

The case study compares two models. The first one is the existing warehouse system and the second one is the new innovative WMS. For the design of WMS implementation was used analysis of current warehouse management based on fixed warehouse positions and common software that keeps track of inventory about individual stock items. The current system of fixed positions does not allow variable use of empty warehouse cells for current needs income and material warehouse. Proposal for the implementation of WMS in turn allows almost 100% utilization of warehouse capacity and reducing the administrative handling time needed to process goods receipt, put-away, warehousing and distribution of goods to the production. For the current calculation of measured values required for the proposal to introduce managed warehouse was used ECC customer production plan in 2017. Of these production plans, can derive data needed to analyse the personnel and technical complexity in the case of implementation of WMS.

Tab. 1 shows the personnel costs in the existing warehouse system. Personnel costs are governed by wage regulation in the ECC. Based on the number of employees (32 people) are determined by the total personnel costs, which amounts to 1,183,000 CZK per month.

**Table 1.** Personnel costs – current state – existing warehouse system. Source: [author based on 15]

	1.Shift	2.Shift	3.Shift	Total (Person)	CZK/Person	Total
Forklifts driver	6	6	6	18	36 000 CZK	648 000 CZK
Operator of material income	2	1	1	4	32 000 CZK	128 000 CZK
Administrator	2	2	2	6	38 000 CZK	228 000 CZK
Shift Supervisor	1	1	1	3	42 000 CZK	126 000 CZK
Manager of Warehouse	1	0	0	1	53 000 CZK	53 000 CZK
<b>Total</b>	<b>12</b>	<b>10</b>	<b>10</b>	<b>32</b>		<b>1 183 000 CZK</b>

Required operating personnel warehouse in 2017 could be changed about the implementation of WMS. In tab. 2 lists the personnel costs in the warehouse after implementation of WMS. Out of 32 employees after the implementation of software and hardware WMS has been optimized six workers. Personnel costs would be reduced from the amount 1,183,000 CZK to 967,000 CZK per month.

**Table 2.** Personnel costs – state after implementation of WMS. Source: [author based on 15]

	1.Shift	2.Shift	3.Shift	Total (Person)	CZK/Person	Total
Forklifts driver	5	5	5	15	36 000 CZK	540 000 CZK
Operator of material income	1	1	1	3	32 000 CZK	96 000 CZK
Administrator	2	1	1	4	38 000 CZK	152 000 CZK
Shift Supervisor	1	1	1	3	42 000 CZK	126 000 CZK
Manager of Warehouse	1	0	0	1	53 000 CZK	53 000 CZK
<b>Total</b>	<b>10</b>	<b>8</b>	<b>8</b>	<b>26</b>		<b>967 000 CZK</b>

In tab. 3 is an overview of the necessary handling equipment in the warehouse before and after the implementation of WMS. The changes that have occurred since the implementation of WMS are saving one forklift (yellow highlighted box in the tab. 3). Number of forklifts can be reduced because WMS reduces the number of forklift drivers. Monthly savings is 24,242 CZK.

**Table 3.** Handling equipment costs. Source: [author based on 15]

Type of Forklift	From	To	Days	Daily Rate	Existing System	WMS
					Price/Month	Price/Month
EFG 110 FN407280	01.01.17	31.01.17	31	620 CZK	19 220 CZK	19 220 CZK
EFG 110 FN350228	01.01.17	31.01.17	31	620 CZK	19 220 CZK	19 220 CZK
EFG 110 FN407311	01.01.17	31.01.17	31	620 CZK	19 220 CZK	19 220 CZK
EFG 216 FN419164	01.01.17	31.01.17	31	782 CZK	24 242 CZK	0 CZK
EFG 216 FN419166	01.01.17	31.01.17	31	782 CZK	24 242 CZK	24 242 CZK
EFG 216 FN419167	01.01.17	31.01.17	31	805 CZK	24 955 CZK	24 955 CZK
EFG-216 MP FN372153	01.01.17	31.01.17	31	805 CZK	24 955 CZK	24 955 CZK
EFG 220 FN406164	01.01.17	31.01.17	31	805 CZK	24 955 CZK	24 955 CZK
EFG 220 FN324425	01.01.17	31.01.17	31	805 CZK	24 955 CZK	24 955 CZK
ERE 225 98007140	01.01.17	31.01.17	31	326 CZK	10 106 CZK	10 106 CZK
ERE 225 98007152	01.01.17	31.01.17	31	326 CZK	10 106 CZK	10 106 CZK
H50D					34 310 CZK	34 310 CZK
H20D					23 480 CZK	23 480 CZK
<b>Total Handling Equipment Costs</b>					<b>283 966 CZK</b>	<b>259 724 CZK</b>

Tab. 4 shows the hardware and software costs of implementation WMS. These costs include software and hardware equipment (radio frequency terminal equipment, radio frequency network including installation and the necessary printers for printing identification cards). The monthly depreciation of software is 36,944 CZK and maintenance is 7,875 CZK. Monthly depreciation on hardware is 19,168 CZK. Total monthly costs for software and hardware of WMS are 63,987 CZK.

**Table 4.** Hardware and software costs of implementing WMS. Source: [author based on 15]

<b>Software (SF)</b>		Depreciation period of 36 months	
Product		Price	
Delivery Chain Integrator		700 000 CZK	
Implementation Services		450 000 CZK	
Expanding Implementation Services		150 000 CZK	
Travel Costs		30 000 CZK	
<b>Total Software Costs</b>		<b>1 330 000 CZK</b>	
<b>Price for maintenance</b>		Price for a year	
Product		Monthly Payment	
Delivery Chain Integrator		<b>94 500 CZK</b>	
<b>Hardware (HW)</b>		Depreciation period of 36 months	
Product	Number	Price/unit	Price
Radio frequency (RF) terminal	9	30 000 CZK	270 000 CZK
Accessories	9	5 237 CZK	47 133 CZK
RF network including installation	1	300 000 CZK	300 000 CZK
Printer	2	36 455 CZK	72 910 CZK
<b>Total Hardware Costs</b>		<b>690 043 CZK</b>	
<b>Total Monthly Costs for Hardware and Software</b>			<b>63 987 CZK</b>

Tab. 5 expresses the logistics costs for material identification in the ECC warehouse. From the available data to determine the total number of printed identification cards (hereinafter IDC) is 660,294 pieces. Print of one IDC worth 0.61 CZK, so they are identifiable costs to the total number of IDC calculated the amount to 402,779 CZK. Costs of hardware and software (column HW and SW) are fixed monthly 29,637 CZK. This amount includes the use of personal computer and printers including consumables. Total yearly costs for material identification are 758,423 CZK.

**Table 5.** Logistics costs for material identification, HW and SW equipment – existing warehouse system. Source: [author based on 15]

Month	Number of IDC	IDC Costs	HW and SW	Total
1	59 432	36 253 CZK	29 637 CZK	<b>65 890 CZK</b>
2	57 436	35 036 CZK	29 637 CZK	<b>64 673 CZK</b>
3	67 187	40 984 CZK	29 637 CZK	<b>70 621 CZK</b>
4	55 804	34 040 CZK	29 637 CZK	<b>63 677 CZK</b>
5	61 649	37 606 CZK	29 637 CZK	<b>67 243 CZK</b>
6	60 996	37 207 CZK	29 637 CZK	<b>66 844 CZK</b>
7	40 073	24 445 CZK	29 637 CZK	<b>54 082 CZK</b>
8	41 201	25 133 CZK	29 637 CZK	<b>54 770 CZK</b>
9	58 316	35 573 CZK	29 637 CZK	<b>65 210 CZK</b>
10	55 231	33 691 CZK	29 637 CZK	<b>63 328 CZK</b>
11	57 078	34 817 CZK	29 637 CZK	<b>64 454 CZK</b>
12	45 892	27 994 CZK	29 637 CZK	<b>57 631 CZK</b>
<b>Total</b>	<b>660 294</b>	<b>402 779 CZK</b>	<b>355 644 CZK</b>	<b>758 423 CZK</b>

Tab. 6 shows the costs for material identification in case of implementation WMS. IDC costs will change, because new IDCs are cheaper. One identification card costs only 0.24 CZK. Changes that occur with this implementation shall remain in hardware and software. Monthly operating costs of hardware and software of WMS are from tab. 4 totally

63,987 CZK per month. As is apparent from a comparison of the tables, the implementation of WMS will increase the total cost of the material identification from 758,423 CZK to 926,318 CZK per year.

**Table 6.** Logistics costs for material identification, HW and SW equipment – WMS. Source: [author based on 15]

Month	Number of IDC	IDC Costs	HW and SW	Total
1	59 432	14 264 CZK	63 987 CZK	<b>78 251 CZK</b>
2	57 436	13 785 CZK	63 987 CZK	<b>77 772 CZK</b>
3	67 187	16 125 CZK	63 987 CZK	<b>80 112 CZK</b>
4	55 804	13 393 CZK	63 987 CZK	<b>77 380 CZK</b>
5	61 649	14 796 CZK	63 987 CZK	<b>78 783 CZK</b>
6	60 996	14 639 CZK	63 987 CZK	<b>78 626 CZK</b>
7	40 073	9 618 CZK	63 987 CZK	<b>73 605 CZK</b>
8	41 201	9 888 CZK	63 987 CZK	<b>73 876 CZK</b>
9	58 316	13 996 CZK	63 987 CZK	<b>77 983 CZK</b>
10	55 231	13 256 CZK	63 987 CZK	<b>77 243 CZK</b>
11	57 078	13 699 CZK	63 987 CZK	<b>77 686 CZK</b>
12	45 892	11 014 CZK	63 987 CZK	<b>75 001 CZK</b>
<b>Total</b>	<b>660 294</b>	<b>158 471 CZK</b>	<b>767 848 CZK</b>	<b>926 318 CZK</b>

Tab. 7 expresses the total cost evaluation, the use of an existing type of warehousing at fixed positions. The right part of the table shows implementation of the WMS. The total savings would be 6 people, so it would reduce personnel costs. WMS could reduce the costs of the warehouse equipment of the forklift. Costs for material identification would increase slightly, but the total yearly cost savings would amount to 2,715,009 CZK.

**Table 7.** Yearly evaluation of total costs. Source: [author based on 15]

	Existing Warehouse System	Warehouse Management System
Number of personnel	32	26
Costs of personnel	14 196 000 CZK	11 604 000 CZK
Handling equipment costs	3 407 592 CZK	3 116 688 CZK
Costs for material identification	758 423 CZK	926 318 CZK
<b>Yearly savings</b>	<b>2 715 009 CZK</b>	

## Conclusion

WMS brings many positive impacts. WMS means in practice that all movement of the material is controlled by software, material is identified by a bar code transmitted with a radio frequency terminal. Workers are minimized errors and increasing the productivity. Processes performed by the warehouse staff can monitor and evaluate at any moment. The system minimizes the complaint allows the merging of orders and guarantees compliance with FIFO (First In First Out).

The aim of this paper was reduced the logistics costs of warehousing in the ECC and propose the implementation of WMS for reasons of logistics cost savings. With the implementation of WMS will be savings on the cost side. Overall it will be reduced the necessary operating staff consists of 32 to 26 workers, also will be reduced the required

handling (warehouse equipment) and slightly will be increased the logistics costs for material identification. Total yearly savings are 2,715,009 CZK.

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