Deployment *Warehouse Management System*: Case study in a Distributor Center and Wholesaler

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ABSTRACT

Currently the companies operate in highly dynamic and competitive environments where inventory management becomes an advantage against competitors when the organization uses experts from warehouse management systems that support the decision-making process. The study describes the implementation of a WMS (Warehouse Management System) management of warehouses in a distributor and wholesale center of the personal care segment and cleaning products Cordilheira Alta / SC. In the methodology, we chose a descriptive research through basic qualitative case study with qualitative approach. The results show that the WMS implementation has improved the decision-making process of the organization in relation to agility, improving the informational reporting and accuracy in the measurement of items. Besides causing noticeable changes in routines performed at the distribution center to demonstrate the efficiency in receiving, allocating, sort, pack and ship the products safely to meet efficiently to customers' requests.

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KEY-WORDS: WMS. Warehouse Management System. Distributor and wholesale center.

Implantação *Warehouse Management System*: Estudo de Caso em um Centro Distribuidor e Atacadista

RESUMO

A gestão de estoque torna-se uma vantagem para as organizações frente a seus concorrentes, quando a empresa utiliza sistemas especialistas de gerenciamento de armazéns que subsidiam o processo de tomada de decisão. Neste estudo, descreve-se a implantação de um sistema WMS (*Warehouse Management System*) de gerenciamento de armazéns, em um centro distribuidor e atacadista do segmento de higiene pessoal e limpeza em Cordilheira Alta/SC. Na metodologia, optou-se por uma pesquisa descritiva por meio de estudo de caso qualitativo básico, com abordagem qualitativa dos dados. Os resultados apontam que a implantação do WMS trouxe melhorias ao processo decisório da organização em relação à agilidade, à melhoria nos relatórios informacionais e à precisão na mensuração dos itens. Além de acarretar mudanças perceptíveis nas rotinas realizadas no centro de distribuição, que demonstram a eficiência em receber, alocar, separar, embalar e expedir produtos de forma segura para atender com eficiência os pedidos dos clientes.

KEY-WORDS: WMS. Warehouse Management System. Distributor and wholesale center.

1-INTRODUCTION

Companies nowadays are inserted in dynamic environments in which the inventory management becomes an item in the search for competitive advantage of organizations, compared to their competitors. Hékis et al. (2013) point out that, when they look for alternatives in the inventory management, some organizations have chosen to supply their products via distribution center (DC). These environments, as components of an organization need to evolve, reduce cost, keep track of their results and still, have focus on their clients' satisfaction. Viana and Rodrigues Neto (2012, p. 1) emphasize that "to keep themselves competitively in the market and achieve efficiency in logistics operations it is essential the deployment of an information system".

To meet this informational demand, it has become increasingly the use of an information system that facilitates the location of products, reduce errors and still meet the needs of customers in a storehouse, warehouse or distribution center (Arbache et al., 2011).

Hékis, Moura, Souza e Valentim (2013) mention that one of the information systems most used for the management of warehouses is the Warehouse *Management System* (WMS), which helps in the organization of centers of distributions or storehouses in order to ensure the agility and quality in material flow, streamline and improve procedures of storage, such as receiving, inspecting, addressing, storing, picking, packing, loading, shipping, issuing of documents and inventory. By integrating information from these procedures, the *software* meets the logistical needs of the company, avoids failures, maximizes the resources and still assists in the decision making process. Moura (1997) states that with a WMS system the company can improve its business into two categories: reducing costs and improving customer service.

The WMS system operates in the management of large quantity of items and its target audience are companies that have high volume (quantitative and financial) in their inventory. Thus, it is understood that data control in enterprises of this nature should be more rigid, especially if

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there are items with high obsolescence (Silva & Silva, 2013). Arbache et al. (2011) mention that the WMS enables the operational optimization through the increase of the operational competitiveness, optimization of spaces, rationalization of resources both for movement and storing, providing this way an environment of increased productivity.

In order to identify the benefits of using WMS, some studies have attempted to analyze theoretically their deployment as the research developed by Pereira, Toquetti, Ricci and Duarte (2010), Viana and Rodrigues Neto (2012) and Silva and Oliveira (2013). In this same line of thought, new studies have investigated the use or implementation of the system in centers of companies distribution (Silva, 2013), in organizations of the furniture sector (Costa & Gobbo Junior, 2008), the food segment (Martins, Brito, Freitas & Nunes, 2010; Arieira, 2012), in the textile sector (Hékis et al., 2013), in companies of supplies in the corporate market (Machado & Sellitto, 2012) or even, in the perspective of reverse logistics (Guarnieri, Chrusciak, Oliveira, Hatakeyama & Scandelari, 2006).

The deployment and use of the WMS allied to new information technologies, when properly used, become a strong differential between organizations that crave the excellence in service to their customers. In this way, organizations are increasingly seeking alternatives to facilitate the management of their activities, the increase in control and the obtaining of precise information, which may in fact accelerate the process of decision-making and thus improve the level of service (Pereira et al., 2010).

In this sense, it arises the central purpose of this research which is to try and describe the deployment of a system WMS (*Warehouse Management System*) of warehouse management, in a distribution center and wholesaler of the segment of personal hygiene and cleaning products in Cordilheira Alta/SC.

2 *WAREHOUSE MANAGEMENT SYSTEM* (WMS)

The technological evolution of the centers of logistics distributions can be attributed to the implementation of Warehouse Management Systems (EMS) also known by the terminology WMS, which arose to replace

the old systems that only handled the inputs and outputs of products of those centers (Hékis et al., 2013).

According to Costa and Gobbo Junior (2008), it is realized a global growth in the use of warehouse management systems and the WMS is a management system whose base is a *software* that is intended to improve the operations of a distribution center, through the management of information and conclusions of tasks, with an acceptable level of control and accuracy of the inventory. The authors mention still that this system has as its main objective to increase the accuracy of the information of the stock, increase the speed and quality of the operations of the distribution center, increase the productivity of the staff and equipment from the storeroom.

For Guarnieri et al. (2006), the WMS is characterized as a system of integrated management of warehouses to operate optimally all activities and information flows that involve the procedure of storage. The activities immersed in this storage procedure include receiving, inspecting, addressing, warehousing, picking, packing, loading, shipping, issuing of documents, inventory, bins management among other functions.

Silva and Oliveira (2013) emphasize that the WMS - which stands out for being a system that has the power to perform the integration between hardware*, software* and peripheral equipment for the management of stock, space, equipment, and labor in activities that involve the storage of products - it fits within the expert systems driven for information management. In this sense, the WMS, when supported by information technology is intended to complement the Management Information Systems (GIS) used by the organizations.

The flow of activities managed by WMS, comprises since the entry of the products in the company until their preparation for delivery in the end customer. This procedure begins with the "entry" of the product in the company, where it is identified by the code and quantity at the time of receipt. The pieces of information of these products are launched into the WMS, through the use of barcode readers and radio frequency terminals or digital keyboards. In the sequence, occurs the weight and cubage configuration of the product packaging with the conference between the

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informed code and the records of this product in the system (Silva & Silva, 2013).

Next, in the "storing" procedure, the system allocates the products based on the *layout* of the company stock. Then, the system performs the record of the location of the product in stock according to the level of the company stock. And still, it elaborates the reception and the route for products that require storage in multiple locations (Silva & Silva, 2013).

Next, the procedure of "inventory management" enables the analysis of the levels of products in each point of storage in the warehouse, the monitoring of quantities and the time of the restocking of the products suggested by the system, in addition to the application for restocking, which is transmitted to the purchasing department or directly to the suppliers via EDI or the Internet (Silva & Silva, 2013).

The procedure of "order withdrawal" involves the receipt of the order that the system decomposes into groups of items that require different types of processing and sorting, grouping according to the location of the points of storage. Finally, the procedure of "preparation for shipment", the customer orders from the same region are chosen simultaneously in order to reach the point of shipment at the same time, are, still held the estimates of Cubage, weight of requests from multiple clients that will be taken by truck, container or rail wagon until the consumer client of these products (Silva & Silva, 2013).

3 MAIN FUNCTIONS OF A WMS SYSTEM

Guarnieri et al. (2006) state hat the WMS has several functions that can support the logistics strategy of a company, such as: planning and resource allocation, concierge, receipt, inspection and quality control, storage, transfer, shipping, inventory, tracking, and reporting.

Costa and Gobbo Junior (2008) emphasize that the main features of the system are traceability of operations, physical and general inventories, planning and control of capacity, definition of characteristics of use of each storage facility, the classification system of items, bathes control, dates of release of quarantines and situations of quality control, separation of

orders, interface with customers and suppliers, calculation of order and content lists, control of routes and loading of vehicles. Arbache et al. 2011) still highlights that the functionality of the calculation about which packages will be needed to accommodate every type of merchandise that will be sent to the customers is only possible, since the data logistics must be registered in definition of the cubage of materials.

Pereira et al. 2010), based on the analysis of the work carried out by Sucupira (2004) and Banzato (1998) say that the main features are: traceability of transactions in real-time, physical and general inventories, defining characteristics of use and of each storage location, classification of items, batches control, quarantines and quality control, separation of orders, interface customer/supplier, calculation of order and the content list, control of routes and loads of vehicles. The authors mention that other functions can be listed and assigned to other procedures of organization, such as programming of order entry, planning and resource allocation, concierge, receipt, inspection and quality control, storage, transfer, shipping and reports.

4 BENEFITS FROM THE IMPLEMENTATION OF A WMS SYSTEM.

In the highly competitive business environment in which they operate, organizations are increasingly dependent on Information Technology (IT) (Hékis et al., 2013). When it is established this relationship of dependence with it, there emerges the need for use of expert systems to assist in the management and consequently in the decision-making process, thus, expert systems like WMS must generate benefits from its implementation.

Ching (2010) affirms that the WMS provides some benefits after their deployment, such as:

A) improvement in the accuracy of the physical inventory versus accounting;

b) improvement in the occupancy of spaces due to addressing the materials;

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C) reduction of errors when collect by radiofrequency (*Radio-Frequency Identification* – RFID);

d) increase of productivity and *online* tasks;

e) improvements in the distribution and control of the cargo;

f) improvement of the operational management;

g) development of the database for strategic decisions.

Arbache et al. (2011) point out that all operations proposed by implementers of the *software* must be in full operation phase, however it is understood that the system will not allow all the company procedures. However, it should be visible the reduction of operating costs and lead *time* of the product after the customer's order.

The benefits of deploying the WMS, according to Hékis et al. (2013), should provide significant improvement in the management of the distribution center, especially in the management of goods, in reducing the lead *time* of products, in optimizing brought by WMS, in relation to information and materials present on the DCs. However, as no system works well if the people who operate are not committed to its proper use, so that the benefits with the use of the WMS can be perceived, the proper preparation and training of people and the commitment of these professionals is a determinant factor for the success or failure of the implementation of any change in the organization.

For Martins et al. (2010), the main improvements obtained with the implementation of the WMS are: agility in procedures, reduction of working hours and increased productivity, improved inventory management, improvement in the management of procedures, fidelity of information and focus on reducing costs and improving the services provided to customers, reducing waste.

From the use of the WMS, Silva and Oliveira (2013) list some positives and negatives points caused by the implementation. Among the positive points by using the system, we have: performance only in the sector of materials; elimination of paper sheets spreadsheets in the control of incoming and outgoing products; better use of space; accuracy in communication and data transmission; less movement in unnecessary storage; greater agility between the procedures of the distribution center;

greater precision in handling; addressing the product; various forms of inventory (addressing, products and data); reduction in the time of separation of products; updating the inventory in real time; less bureaucracy and more rapid information; increased security at the conference of the goods; control of the productivity of operators; non-suspension of the activities of the deposit for the realization of Inventories.

The authors point out as negative points the use on the part of the system of specialized labor; the need to be integrated with another managerial system; the need for investments in antennas for no loss of signal transmission of radiofrequency. Thus, the installation of this system only pays off if the company has a high volume of items in stock.

In line with the notes of Silva and Oliveira (2013) about the positive and negative aspects arising from the use of the WMS, Silva (2013) mentions as positive the procedures directed towards the separation of orders, such as: increased productivity on the part of employees, consequently the use of a smaller number of people as the volume of orders increases; better management of resources due to the demand; improvement in the quality of the order, minimizing errors (of products, quantities and customers); reduction in the time of separation of the order. Another positive aspect of the WMS is the traceability and security in the development of activities within the distribution centers with efficient management of human and physical resources. However, one of the negative points arising out of the use of this system is the resistance of employees to the new procedure established with the *software*.

5. EMPIRICAL STUDIES WHICH APPROACH THE WMS

Among the previous empirical studies regarding the implementation of the WMS, is the one conducted by Guarnieri et al. (2006), who analyzed the adaptation of the traditional WMS, in order to be able to use it also for supply chain management of reverse logistics. In their findings, the authors mention that most traditional functions of WMS, traditionally used to manage the logistics phones can also be used in reverse logistics. They also highlight that it is possible this way of resolving the immediate need of the

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companies in managing their waste more in a more organized way, optimizing time and resources until the time it is developed specific systems to this function.

Costa and Gobbo Junior (2008) presented a proposal of steps for the implementation of the WMS system in distribution centers. The authors conducted a study in a large company of retail business furniture to work together with the manager system. At the findings of this research, it was revealed that through the WMS it was possible to propose steps for the implementation in a distribution center (CD), in addition to conducting a survey of the operations of the old storehouse and the new CD of the furniture company.

With a case study of a company of food sector which has a distribution center located in the state of São Paulo, Martins et al. (2010) have intended to show the importance of using WMS, when they made an approach on its concept, dealing also with its goals and features, the authors emphasized its benefits, showing its deployment procedure in the food company. The results of this study demonstrate that the WMS is able to perform at any time a survey of the situation of the products, the employees and the tasks indexed in the database. In addition, the functions described of inventory management, the system performs the monitoring of services performed, generates files for the achievement of physical conference, for surveys of *performance*, traceability, among other activities. The mains difficulties listed with the implementation of the WMS deployment, stood out: Inventory of stock, training of staff who came from a little automated system, adjustments of the first and second version of the software.

Based on a theoretical research, Pereira et al. (2010) presented among the various systems that make up a logistics integrated system, the WMS, which assists in the management of warehouses and in the internal movement of materials, analyzing the most appropriate way to implement it and, thus, contribute to the success of new deployments of the system or for better management of tools already deployed, but without attempting to create an ideal model for the deployment of WMS. The research findings

reveal an exponential increase in deployments of WMS by companies due to the success obtained in supply chain management.

Arieira (2012) conducted a case study to examine the procedure of development and deployment of a WMS system in a food processing company from the northwestern region of Paraná. As specific objectives, it was attempted to:

a) identify the main aspects of attention and difficulties that must be overcome for the development of a WMS system in an industry;

b) verify the main difficulties encountered during the implementation of the WMS;

c) make a critical analysis of the fundamental aspects that involve the procedure of successful deployment of a WMS system.

The survey results show that users have the perception of the importance of the system for the management of the organization, but the little training on the part of the company to manage appropriately is presented as a restrictive element in the deployment and use of the system

The researchers Machado and Sellitto (2012), through the analysis of a distribution center for supplies in the corporate market, based in the city of São Leopoldo, state of Rio Grande do Sul, aimed at describing how the deployment and use of a management system for warehouses (EMS) can help to increase productivity, reduce errors and acceleration in the flow of information in a distribution center. The results show that after four months of observation in the company, it was detected a significant improvement in procedures, which strengthens the hypothesis that the choice and implementation of an EMS were beneficial to the company studied.

From bibliographical research based primarily on authors such as Ballou, Bowersox, Closs and Banzato, Viana and Rodrigues Neto (2012) aimed to identify the characteristics, the features and the benefits provided by a WMS system, determinant of competitive advantages for the supply chain. The results indicate that the WMS, system is very important for the chain, because it helps in the whole procedure of storage, improving the flow of materials and information, streamline operations with the maximum utilization of human and physical resources, as well as generates precise information that assists in the decision making process.

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When analyzing a large company in the textile sector from Natal, Rio Grande do Norte, the researchers Hékis et al. (2013) attempted to describe the improvements resulting from the implementation of a management system of the distribution center with a focus in the area of processing of goods and analyze the current system of management information of the company examined. The results show that there was a reduction in *lead time* of goods by 24%. It was noticed, also, the increase in employee productivity and improvement at the management of the distribution center, as well as the elimination of locations for predetermined goods, optimizing the procedure and the displacement of employees.

Silva (2013), when analyzing a distributor that has been operating in the state of Rio Grande do Sul and Santa Catarina for 22 years, had the purpose of presenting the qualitative results obtained with the implementation of logistics technology in the separation of orders. The results of the study indicate that the use of the WMS in this activity enabled the company to make better management and operationalization of the demand for orders and even helped in the level of logistical services provided to its customers, thus contributing to the company to remain on the market where it operates.

And finally, from a bibliometric study, Silva and Oliveira (2013) raised the contributions of WMS technologies and applications and products for data processing (SAP R/3 MM) to materials management, under the dimensions and variables of qualitative analysis: attributes, functions, convergences, positive and negative points of these systems of management of materials. The results show that the systems can contribute to the technological upgrading of the organization, in addition to improving the possibilities for control over the procedures to increase productivity, reduce costs, integration between the various activities of the organization and, by having access to quality information in real time, for making decisions about the whole productive chain in which the company is inserted. It is also realized, that the WMS has advantage before the SAP R/3 MM for its flexibility and autonomy, since the manager may cause changes in the system according to his or her need and integrate it with other information system.

6 RESEARCH METHODOLOGY

In this section, it is described the deployment of a WMS system (*Warehouse Management System*) of warehouse management, in a distributor and wholesaler of the segment of personal hygiene and cleaning products in Cordilheira Alta/SC. It was opted for a descriptive research through a case study with qualitative approach of the information.

The descriptive research to Gil (1999, p. 70) has as main objective "to describe the characteristics of a given population or phenomenon or establishment of relations among the variables". Soares (2003) also mentions, in relation to surveys of this nature, that the researcher interprets the facts, looking for solutions to the problem and presents many uses, how to describe the complexity of a given hypothesis or problem; analyze the interaction of the variables studied; submit contributions in the procedure of change, creation or formulation of opinions and solutions, among others.

The case study was conducted between July and November 2014, in a distribution company and wholesaler, in order to understand complex social phenomena of this organization, whose company name will be preserved for strategic issues. In relation to the case study, Yin (2003, p. 21) mentions that it is "an investigation to preserve the holistic and significant characteristics of real life events". It is worth mentioning that the typology of case study adopted in this research is characterized as a qualitative case study. According to Merriam (1998), studies of this nature are characterized as researches that contain some characteristics of qualitative research, but do not have all of the variables to be treated as a case study, whose aim is to deepen into a unit of analysis clearly specified.

The data were collected through secondary sources which comprised managerial documents, accounting reports, reports of the management systems of the company and analysis of the *homepage* during the months between July and November of 2014. We also used, in October 2014, the technique of collecting data from direct observation on company premises in which they occur, this being supported by annotations and electronic devices. Marconi and Lakatos (1999) highlight that in this type of data

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collection there is an action planning, with a driven remark supported by pictures, remarks, scales and mechanical devices such as some of the instruments that can be used in this remark. Finally, open interviews were held, an hour and thirty minutes each, with three managers of the organization that work in the departments of receipt, allocation and shipment of goods.

In the analysis of the data, it was a qualitative approach focused on the analysis of the content of managerial reports, interviews and remarks arising from direct observation. Richardson (1999, p. 39) explains that "the investigations that turn to a qualitative analysis have as object complex situations or strictly private". Prodanov and Freitas (2009, p. 66) understand the qualitative research

> As a category of research which has as its object of study a unit in depth, and may be a subject, of a group of people, of a community, etc. It is required some basic requirements for their implementation, including: severity, Objectivities, originality and consistency.

Thus, the analysis of information collected had as theoretical allowance the studies by Pereira et al. (2010) based on the works of Sucupira (2004) and Banzato (1998) in relation to the functionalities of the system. As to the strengths and weaknesses arising from the implementation of the system, the base was the survey conducted by Silva and Oliveira (2013) and Silva (2013); and, finally, in the analysis of the improvements offered by WMS, the work done by Hékis et al. (2013).

7 DATA ANALYSIS

In this topic, it is presented the characterization of the company examined, it is explained about the main features of WMS, it is examined the strengths and weaknesses of the deployment of the WMS system, and, finally, it is pointed the improvements realized by the company after the implementation of the WMS in the management of the warehouse.

7.1 CHARACTERIZATION OF THE COMPANY EXAMINED

The company Beta, fictitious name used to preserve its identity, is located in the city of Cordilheira Alta in the region of the state of Santa Catarina. Founded on August 01 1997 by the owner and his sons, from the division of the company Gama, Beta has configured itself as a promising and new organization of wholesale branch in the southern region of the country.

In the pursuit of continuous improvement, the company, which currently has a distribution center with almost 10 thousand square meters of built area and 40 thousand square meters of total area in the city of Cordilheira Alta/SC, needs new investments in its distribution center to continue growing. Facing this prospect, it has two projects for expansion, the first being turned to the automation of separation of products from the distribution center with the implementation of a new system of management information and the second project for opening a branch in the city of Nonoai, in the state of Rio Grande do Sul.

7.2 KEY FEATURES OF WMS

The main features offered by WMS, according to Pereira et al. (2010) with subsidies in the works of Sucupira (2004) and Banzato (1998), it is described in Table 1, as well as a comparison with the observed reality in the company within the scope of this study.

Feature	Description suggested by Pereira et al. (2010) based on Sucupira (2004) and Banzato (1998)	Findings of the research
(A) Traceability of transactions in real time	The entire operation performed in the system can be traced *online*.	The traceability occurs *online* and generates accurate information about the stock.
b) General and rotating Physical Inventories	With the possibility of parameterization of the user.	The inventory is conducted online, and it is not necessary to stop the procedure of separation to accomplish it. It can be performed per item or per

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Feature	Description suggested by Pereira et al. (2010) based on Sucupira (2004) and Banzato (1998)	Findings of the research
		address.
C) Planning and control of capacity	Planning activities and analyzing bottlenecks.	The activity control parameterizes procedures and identifies the right order of tasks.
D) Definition of characteristics of use of each storage site	Provides the mapping of storage sites, identifies all addresses and the characteristics of the items that can be stored in each location The system shall convene the operators to place each material in the appropriate address for proper protection and maximum productivity of the movement of items stored.	Due to the rotation of the products, it is performed the mapping of what is the best address that makes it easy the location and movement of products
e) Control of batches, quarantines and quality control	Record on each unit of storage of information from batches of manufacture, allowing the identification of the goods of the batches (if they were sent to internal or external customers) for traceability of transactions. The system still informs the situation of each material in its learning unit: adoption, rejection, quarantine, inspection, situations of blockade, among others.	In the logistics registration of the products, are communicated all possible information so that, in time to allocate some materials, the operator can know what the purpose is, where to be sent, and how it should be stored, making it easy its collection and shipping.
f) Orders separation (*picking*)	Parameterized by FIFO methods (*First in First Out*), LIFO (*Last in First Out*) and others.	All information of separation by *picking* are performed by classification of products and allow to advise the location in which and the items must be stored to be sold and separated in fractional quantities.
g) Interface customer/supplier	Communication with the internet support, to receive from the supplier the consignment of goods in advance and schedule the receipt. In the same way, receive information from the	The WMS is coupled with another system integration with customers and suppliers. The system (Hbsis) informs in real time

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Feature	Description suggested by Pereira et al. (2010) based on Sucupira (2004) and Banzato (1998)	Findings of the research
	customer, as the order placed and sales invoice for local printing.	over the internet which the locality of a cargo, request or delivery is. It also informs the number of *danfe*, quantity and values of the bill of sale.

Feature	Description suggested by Pereira et al. (2010) based on Sucupira (2004) and Banzato (1998)	Findings of the research
g) Interface customer/supplier	Communication with the internet support, to receive from the supplier the consignment of goods in advance and schedule the receipt. In the same way, receive information from the customer, as the order placed and sales invoice for local printing.	The WMS is coupled with another system integration with customers and suppliers. The system (Hbsis) informs in real time over the internet which the locality of a cargo, request or delivery is. It also informs the number of *danfe*, quantity and values of the bill of sale.
h) Calculation of shipping packages and contents list	Algorithms to calculate the packages needed, with the issue of listing of the contents, gross and net weight of each package.	All products separated and dispatched contain information on their logistics registration, which informs the size, weight, height, width, diameter and length of the products. After calculating the cubages of each item, the system suggests the box size for packing the products. The next step is to add up the total cubage of volumes (boxes) that will compose

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Feature	Description suggested by Pereira et al. (2010) based on Sucupira (2004) and Banzato (1998)	Findings of the research
		the cargo and subsequently set the vehicle for delivery.
I) Control of routes and loading of vehicles	Registration of routes and control of volumes carried by vehicle. The transport documents such as bill of loading and cargo manifest can be transmitted to carriers, to expedite the release time of vehicles. The integration with carriers also allows the transmission of data received by customers (the invoice stub), allowing the evaluation of performance of the carrier and tracking of orders for customers.	The company has its own fleet and, thus, it makes it easy the bureaucracy that involves the transport of products, since it is not necessary bills of loading and cargo manifests However, it uses the system for the routing of deliveries and searches general data about the cargo, such as weight and Cubage, to designate the choice of vehicle.

Table 1: Main functions of a WMS system

Source: adapted from Pereira et al. (2010)

According to Table 1, it is observed that the company studied uses in its operations, with the implementation of the WMS, all features listed by Pereira et al. (2010). The company in order to keep up with the technological innovations and provide informational support for their managers sought in information technology a system that could meet its needs and, still drive improvements in their procedures and consequently meet the needs of its customers with efficiency and effectiveness. It is understood that the findings of this study corroborate the results of Costa and Gobbo Junior (2008) and Oliveira et al. (2010), once that its functions might be perceived and identified in the company examined.

7.3 STRENGTHS AND WEAKNESSES OF DEPLOYMENT OF THE WMS system

To identify the strengths and weaknesses from the implementation of the managerial WMS system, we sought as a basis the research of Silva and

Oliveira (2013) and Silva (2013) to compare with the findings of this study exposed in Table 2.

	Silva and Oliveira (2013)	Finding of this research
POSITIVE POINTS	a) It operates only in the sector of materials; B) It eliminates the use of paper sheets and spreadsheets for the control of input and output of materials; C) better space use; D) Precision in communication and data transmission; E) Unnecessary moving in the warehouse; F) it addresses the product; G) several forms of accomplishing inventories (addressing, products, data); H) reduction in the time of separation of products; I) reports issuance; J) more security at the conference of goods; K) control of productivity of operators; L) it is not necessary suspend the activities of the warehouse for inventories.	A) more agility of operational procedures; B) eliminates the use of spreadsheets on paper for controls of operations within the CD; O) receipt of goods quickly and accurately; D) it reduces the time of separation and shipping of products; E) *online* transmission of data and operations carried out in real time; F) it resizes the physical space of the CD by means of precise addresses; G) controls and measures the production per operator; H) easy location of products within a warehouse that has a *mix* of different products; I) safety at the conference of goods; J) it is not necessary to stop the operational procedure of the company to perform the inventory; L) issuance of reports; M)it offers countless ways to perform a count of the stock.

To be

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NEGATIVE POINTS	a) It requires training and specialized labor; b) it needs to be integrated with another managerial system; c) it requires investment in antennas for no loss of signal transmission of radiofrequency; d) it only compensates for the installation if the company has a high volume of stock.	a) it is essential to train all employees involved in all procedures of the CD; b) the WMS must be interconnected with the administrative management system of the company, so that the other procedures are carried out effectively; C) it is necessary to install and maintain regular antennas of radiofrequency, because, if they are not in perfect operation, it is possible to lose data update and non-completion of operations designated by the WMS; d) It becomes interesting the implementation of the WMS for companies with a large number of items in their inventory; e) need for a trained professional, and designed only to this function, for the continuous follow-up in all operations.

Table 2: Strengths and weaknesses generated with the implementation of the WMS system

Source: adapted from Oliveira and Silva (2013)

The positive and negative points raised by the managers of the company examined, especially in the management of the warehouse, corroborate the findings of Silva and Oliveira (2013). Regarding the weaknesses observed in the implementation of the WMS at the company analyzed, the findings corroborate Silva (2013), once that it is realized the resistance of the employees to the new procedure established by WMS, which has resulted in the increase of employee turnover, especially of those old professionals.

7.4 MAJOR IMPROVEMENTS PERCEIVED BY MANAGERS REGARDING THE DEPLOYMENT OF THE WMS

Among the benefits perceived by managers with the deployment and use of the system in the company examined, it is possible to list some

improvements identified in the management of the distribution center from the interviews carried out:

a) correct registration of input and output of goods in the storage system;

b) generation of a history of requests for purchase, replacement and requisition of materials;

c) issuance of reports of sale, outputs and finished products ready for shipment;

d) better allocation of products within the CD, this due to rotation, weight, shape and size of collection at the time of separation of the application;

e) Issuance of documents and reports before the activities developed in real time;

f) update of online, inventory *which* allows the external seller to obtain exact information of the quantity of a given product available in stock;

g) establishment of performance indices per activities;

h) an increase of 80% in reliability in relation to the quantity of items available, reserved in the orders and items billed per product;

i) analysis of how many days the products in stock are without rotation or sale;

j) reduction in the number of errors in the separation of orders;

l) allocation of products in stocks directed from the logistics registration of products;

m) increased productivity of employees of the warehouse;

n) greater agility at customer service;

o) differential in the market before its competitors;

p) larger volume of information in relation to purchases made for each client;

q) reduction of costs regarding the activities of logistics procedures;

r) facilitating the separation of packages loaded on vehicles, which provides agility in the supply to the final consumer;

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s) resizing through the control of the *mix* of products offered by the company;

t) registration of new products with greater safety and less bureaucracy.

From the benefits listed by managers, it is possible to highlight, in relation to the implementation of the WMS at Beta company, those that stood out, in their opinion, regarding the improvement of the business in different ways: reducing costs, minimizing the time and improvement in services provided to customers, as well as the identification of the *status* of the flows of the activities of the warehouse related to the receipt and the separation of products. Another relevant aspect is the integration of WMS to the managerial system used by the company, which provided effective control of inventory per address in the warehouse or product, reduction of losses of the stock. In the meantime, the management system of the company presents information related to sales, returns and faults. The WMS system passes information on the entry of products, allocation and shipping, and finally there is the crossing of the information coming from the two systems, which help in the decision making process of the company.

Based on the perception of managers, it is understood that the findings of this research corroborate the benefits highlighted by Hékis et al. (2013) and Martins et at. (2010) when mentioning that the WMS, leads to a significant improvement in the management of the CD primarily in the management of goods, reducing the lead *time* of products, optimizing the information and products stored in the company. And still, the system streamlines the procedure, reduces hours of work and increases productivity, improves inventory and procedures management, promotes fidelity of information, reduces costs, improves the services provided to customers and reduces waste.

After the implementation of the WMS, and with all the procedures running in a controlled manner and providing accurate results for decision-making, the company has achieved great results with the deployment of the software. Moreover, the noticeable change in routines performed by CD, which demonstrate the efficiency in receiving, allocating, separating, packing and shipping products safely to meet with efficiency the customer's

orders. To illustrate the performance of the system WMS, Table 1 presents the duration time of the procedures in the distribution center before and after the implementation of the WMS, at the company analyzed.

Table 1: Time of duration of the procedures on CD before and after the implementation of the WMS

Procedures of WMS on the operations before and after its deployment.

Analysis done within the eight hours of work (480 minutes)

Steps	Lead Time	Before WMS	fter WMS	% occupied before the deployment of the WMS	% occupied after the deployment of the WMS	Results Before and After
1st	Receipt	0:22:0	0:22:0	4.58 % of the time	4.58 % of the time	0.00
2nd	Conference	2:26:0 0 AM	2:32:0 0 AM	5.42 % of the time	6.66 % of the time	+1.24
3rd	Reserve for daily orders	No data	2:06:0 0 AM	No data	1.25 % of the time	+1.25
4th	Addressing	2:04:0	2:05:0	0.83 % of the time	1.04 % of the time	+1.25
5th	Warehousing	NO DATA	2:09:0	No data	1.87 % of the time	+1.87
6th	Allocating at the CD	2:03:1 5 AM	2:05:0 0 AM	0.65 % of the time	1.04 % of the time	+0.39
7th	Replacement of *Picking*	2:07:0 0 AM	2:03:1 5 AM	1.45 % of the time	0.65 % of the time	-0.80
8th	Orders separation	2:04:0 0 AM	2:02:3 0 AM	0.83 % of the time	0.48 % of the time	-0.35
9th	Orders conference	2:03:1 5 AM	2:03:0 0 AM	0.65 % of the time	0.63 % of the time	-0.02
10th	Packaging of the fractional goods	2:02:1 5 AM	2:02:0 0 AM	0.44 % of the time	0.42 % of the time	-0.02
11th	Allocation at the Shipping box	2:01:3 0 AM	2:00:3 0 AM	0.27 % of the time	0.06 % of the time	-0.21
12th	Shipping	2:08:4 5 AM	2:06:0 0 AM	1.76 % of the time	1.25 % of the time	-0.51
13th	Inventory	2:16:0 0 AM	2:07:3 0 AM	3.33 % of the time	1.52 % of the time	-1.81

Source: research data

From Table 1, it can be seen that the results of the deployment of the WMS in the company Beta regarding the procedure "Receipt" did not suffer

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amendment in its time considering before the WMS, and after the deployment of the WMS in the company. For the procedure "conference of goods", held after the unloading of the products in the distribution center, it was observed an increase of six minutes, or 1.24%, compared to the procedure before the WMS. The deployment of the system added a new procedure to CD, the "reserve for daily orders ", which has resulted in 1.25% increase in time in the daily demand of the orders.

The procedure of "addressing" increased its time from four minutes to five, i.e., an increase of 0.21% in the time that symbolizes the allocation of the products in free sites to receive certain products. Next, the procedure of "warehousing" of products in *picking,* also increased after the implementation of the WMS, causing an increase of 1.87%, i.e., nine minutes. Regarding the "Allocation of goods at the CD", also increased the time of the operation of the CD, since each product has a cubage and the WMS offers the best location for the product to be stored. However, the procedure of "replacement of the *picking"* showed a reduction 0.80% at the time occupied, which demonstrates the efficiency of the receiving procedure.

In the procedure of "separation of goods", one of the priorities of the WMS, it was obtained a reduction in the time of the order of 0.35%; and the procedure "conference of products", which relies on the movement of approximately 12,500 items, showed a reduction of 0.02%. Regarding the procedure of "packaging of goods", which also showed a drop of 0.02% in its time as a result of measurements of weight and cubage of products made from the address in WMS, becomes more secure. And the procedure of "Allocation of products in the box of shipment" showed a significant decrease in the order of 0.21%, due to packaging being well distributed, streamlining the handling in the CD. Concerning the procedure of "shipping", a reduction 0.51% at the time; but the greatest reduction in time occurred in the procedure of "inventory" with 1.81% of the operating time of the tasks of WMS.

8 FINAL CONSIDERATIONS

The study aimed to describe the improvements provided by the deployment of a WMS system of Warehouse Management in a distributor and wholesaler of the segment of personal hygiene and cleaning products in Cordilheira Alta/SC. In the methodology, it was decided to perform a descriptive research with a qualitative case study with a qualitative approach of the data. Data were collected through managerial documents, accounting reports, reports of the management system of the company and the analysis of the *homepage* supported by the technique of direct observation during the months from July to November 2014, as well as interviews with three managers of the company analyzed.

Regarding the main features of the WMS system, it is possible to improve effectively the procedures of CD, as well as the traceability of products online, with inventories prepared effectively, in that the products are not counted separately, but measured by addresses. It is verified an improvement in the parameters of the procedures, which means better occupation of time and in mapping of products by collection site, which facilitates the accessibility of each product within the CD. From the families of products, there are subdivisions, this results in efficient allocation of fractional items in the *flow rack*. The control by batches, expirations dates and shipping is carried out at the time of entry of the product, which implies facilities in the internal handling and in replacement (*kanban*). The *picking* provides allocation and shipping of lightweight and low volume materials, which are caught with ease and allocated based on the classification of the ABC curve of products. After the separation of the products, the system offers a calculation by weight and Cubage, whereby it is directed the best package to case the products, and consequently the sum of these volumes results in weight and cubage total of the cargo. This assists in the decision to choose the vehicle that will perform the transport up to the end customer.

As to the strengths and weaknesses observed from the deployment of the WMS, it is realized that in general the company suffered negative consequences in the procedure of "Receipt" of the products with the deployment of the system, due to the large volume of training carried out by operational staff and the high costs of implementation of the WMS

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system. In contrast, the strengths perceived after the efficient use of the *software* are perceptible, since the products require a shorter time of handling and the orders are separated with more agility, which leads to efficiency gains around 6% of daily sales.

When it comes to major improvements perceived by the deployment of the system, it appears as key points listed by the interviewees:

a) reduction of time and operational costs;

b) quick and efficient determination in the situation of the stock of each item;

c) Accurate reporting of input of goods, service orders and output of materials;

d) better use of internal spaces of the CD;

E) fast and precise inventories.

Finally, it can be concluded that the deployment of the WMS has brought improvements to the decision-making process of the organization concerning the agility, the improvement in reporting and the accuracy in the measurement of the items. It also brought about, noticeable changes in routines performed at the distribution center which demonstrate the efficiency in receiving, allocating, separating, packing and shipping products safely to meet with efficiency to the requests of the customers, which confirm the empirical studies above along the theoretical framework.

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