WAREHOUSE PERFORMANCE MEASUREMENT – A CASE STUDY

Ilieş Liviu

Babeş Bolyai University, Faculty of Economics and Business Administration, 58-60 Teodor Mihali Street, Cluj-Napoca, Romania liviu.ilies@econ.ubbcluj.ro, 0264-41.86.52/3/4/5

Turdean Ana-Maria

Babeş Bolyai University, Faculty of Economics and Business Administration, 58-60 Teodor Mihali Street, Cluj-Napoca, Romania a_m_turdean@yahoo.com, 0742790666

Crişan Emil

Babeş Bolyai University, Faculty of Economics and Business Administration, 58-60 Teodor Mihali Street, Cluj-Napoca, Romania emil.crisan@econ.ubbcluj.ro, 0264-41.86.52/3/4/5

Companies could gain cost advantage using their logistics area of the business. Warehouse management is a possible source of cost improvements from logistics that companies could use during this economic crisis. The goal of this article is to expose a few best practices used in warehouse performance measurement which lead to performance improvements. Warehouse performance measurement refers to the measurement of: optimal use of storage space, customer relations activity, quality level, assets usage and costs. What are the warehouse performance indicators? How are they calculated and how are they interpreted? How can a manager use them in order to improve the warehouse performance? This paper will answer all these questions and will also present the way in which using performance indicators in a warehouse belonging to a company from Romania, S.C. TUDOR S.R.L., can lead to specific solutions.
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1. INTRODUCTION

The purpose of companies is to gain competitive advantage. One way to achieve this is by lowering logistics costs. The reduction of logistics costs diminishes the total cost of goods sold and therefore it helps companies have a higher profit margin or a cost advantage in comparison with their competitors. The present article brings solutions regarding one side of logistics: warehousing.

In 2008, there were a few reports around the world regarding logistics costs, respectively warehousing costs. The first one, done by **Establish Incorporation**, emphasised costs as the strongest force in driving decisions in logistics. The warehousing costs decreased due to rationalisation of locations. In 2008, warehousing costs were about 20% of the total logistics costs in North America. The same study suggests that in Europe warehousing costs were higher. **The European Logistics Report** 2008 considered the reduction of costs essential in warehousing. In the Central and Eastern Europe there was a strong construction activity last year, but despite this fact, the direct investment in warehousing property decreased by 38%. Warehouse construction increased in Romania because of low cost, a growing consumer market and the growing activity around the Constanţa port. **The European Distribution Report** (2008: 5) revealed the rent for warehousing purposes, the land price and the building costs in major cities from Romania. These studies emphasise the importance of logistics and warehousing costs at international level. That is why we consider improving management best practices regarding logistics, in general, and warehousing, in particular, a must for Romanian managers.

The structure of the article is as follows: the first part is a literature review for warehousing performance management (the goal is to present several indicators used at international level), then we try to solve the problems related to a warehouse from Romania, belonging to S.C. TUDOR S.R.L.

2. LITERATURE REVIEW

Performance refers to the way in which work is done. There can be a good performance or a poor one. But what is **performance measurement**? Neely et al. (1995: 86 – 146) defined it as the

process of quantifying the efficiency and effectiveness of an action or activity. The purpose of performance measurement is to find out whether things are going the right way and, if not, to find what were the causes that generated a poor performance. After this step, there have to be found solutions for improving performance. There are several reasons for measuring performance: for improving performance, for avoiding inconveniences before it's too late, for monitoring customer relations, for process and cost control and for maintaining quality (Ackerman, 2003: 1). The main instruments for assessing performance are performance indicators, also named key performance indicators. They are specific characteristics of the process which are measured in order to describe if the process is realised according to pre-established standards. The best way to use indicators is to compare process values with normal, standard values. If there are poor results, poor performance, in reality, improvements for the process have to be made. Indicators are used basically for comparison with expected values. They are the control system of the studied process. In our case, setting an indicator system for warehousing activity is the key for performance improvements, as it shall be presented in our example. We present here some key *indicators that are used around the world to measure warehouse performance*:
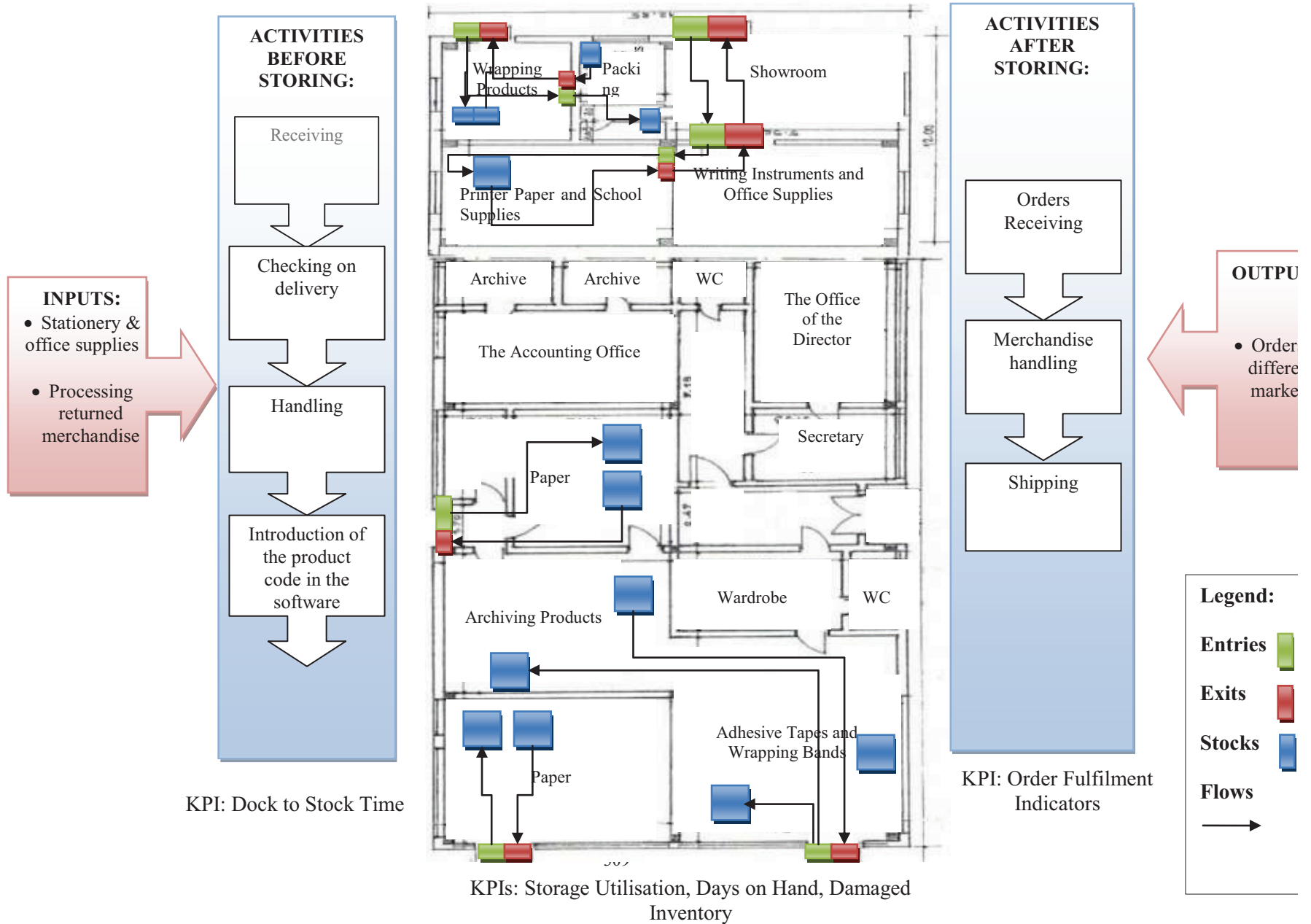
- Colson and Dorigo (2004: 332-349) present a software tool which allows selecting public warehouses according to the following criteria: storage surface and volume; dangerous items; possibility for temperature control; separation of storage areas; geographical distance to highway connection, train, waterways; certification; opening hours; assistance with customs; use of technology; handling equipment; number and characteristics of docks etc;

- Krauth et al. (2005: 5-6) classify around 130 indicators used for assessing warehouse performance, such as storage surface, storage volume, storage racks, number and characteristics of docks, pallets per hour, pallets per square meter, opening hours, and assistance with customs;

- Last but not least, John M. Hill (2007: 20-23) uses three types of indicators: order fulfilment, inventory management and warehouse performance. Some of the indicators proposed by John M. Hill are relevant for S.C. TUDOR S.R.L. activity, so we have decided to use them.

3. CASE STUDY
3.1. SHORT PRESENTATION OF THE COMPANY
S.C. TUDOR S.R.L. was opened in Bistriţa in 1992 as a family company with three associates. Until 1997, the firm functioned sporadically, producing and selling knitwear. In 1997, the firm changed its field of activity into wholesale and retail of stationery, office supplies, consumables and wrapping products. Nowadays, the company has three shops and two warehouses – one rented and one owned by the enterprise. S.C. TUDOR S.R.L. has 30 suppliers and about 500 customers. In 2008, the firm had a turnover of 4.850.710 lei, being the leading firm selling stationery and office supplies from Bistriţa-Năsăud district in the last four years.

The warehouse owned by the company is located in Bistriţa and was acquired in 2003. The location of the warehouse was chosen for the following reasons: it is placed near the trucks route, there is an easy access to the facility, and it has a parking area for the cars of the firm.

ACTIVITIES BEFORE STORING:

Receiving

↓

Checking on delivery

↓

Handling

↓

Introduction of the product code in the software

KPI: Dock to Stock Time

INPUTS:
- Stationery & office supplies
- Processing returned merchandise

ACTIVITIES AFTER STORING:

Orders Receiving

↓

Merchandise handling

↓

Shipping

KPI: Order Fulfilment Indicators

OUTPU
- Order differe marke

Wrapping Products

Packing

Showroom

Writing Instruments and Office Supplies

Printer Paper and School Supplies

Archive

Archive

WC

The Office of the Director

The Accounting Office

Secretary

Paper

Archiving Products

Wardrobe

WC

Adhesive Tapes and Wrapping Bands

Paper

KPIs: Storage Utilisation, Days on Hand, Damaged Inventory

Legend:

Entries

Exits

Stocks

Flows →

The building has 467 square meters; it has few rooms for storing the products (on shelves or on pallets), and offices for the whole firm.

3.2. WAREHOUSE DESCRIPTION

For describing the warehouse we have performed a process mapping. It is a useful way for depicting all operations that take place in the warehouse. On the bottom of the map, we also provide the indicators to show at what operations of warehousing they refer. The warehouse has three zones: the first one (the bottom of the map) has three rooms for storing products: one for adhesive tapes and wrapping bands, one for paper and one for archiving products; a toilet and a wardrobe; the central zone of the warehouse - a room for storing paper, a delivery area, the offices, two archives and a toilet; the last zone (the upper part of the map) - a room for printer paper and school supplies, one for writing instruments and office supplies, two for wrapping materials, and a showroom. The warehouse stores about 1700 different types of products. You can check the process map in the figure above.

3.3. USING PERFORMANCE INDICATORS

We shall use for performance improvement the performance indicators we have described above in the literature review area. The purpose is to identify the poor performance inside the warehouse. As we mentioned above, we are using John M. Hill's indicators to assess the performance of the warehouse, grouped into three categories: "Inventory Management", "Warehouse Performance" and "Order Fulfilment" (2007: 20-22). The values written in green indicate that the operation is going smoothly and red means that there are problems. The indicators followed by "min." should be as small as possible and the ones with "max." should have values as high as possible.

Table 1. **Inventory Management**

MEASURE	CALCULATION	VALUE
Damaged Inventory (min.)	Total Damage (lei) / Inventory Value	0.4 %
Days on Hand (min.)	Avg. Month Inventory (lei) / Avg. Daily Sales/Month	41 days
Storage Utilisation (max.)	Avg. Occupied Sq. m. / Total Storage Capacity	80 %
Dock to Stock Time (min.)	Total Dock to Stock Hrs. / Total Receipts	0.75 hours (45 minutes)

Table 2. **Warehouse Performance Indicators**

MEASURE	CALCULATION	VALUE
Orders per Hour (max.)	Orders Picked or Packed / Total Warehouse Labour Hrs	4 orders/hour
Items per Hour (max.)	Items Picked/Packed / Total Warehouse Labour Hrs	80 – 100 items/hour
Cost per Order (min.)	Total Warehouse Cost / Total Orders Shipped	5.042 %
Cost as % of Sales (min.)	Total Warehouse Cost / Overall Sales	2.08 %

Table 3. **Order Fulfilment Indicators**

MEASURE	CALCULATION	VALUE
On-Time Delivery (max.)	Orders On-Time / Total Orders Shipped	98 % on-time deliveries
Order Fill Rate (max.)	Orders Filled Complete / Total Orders Shipped	98 % complete deliveries
Order Accuracy (max.)	Error-Free Orders / Total Orders Shipped	98 % deliveries are error-free
Order Cycle Time (min.)	Actual Ship Date – Customer Order Date	1 – 48 hours
Perfect Order Completion (max.)	Perfect Deliveries / Total Orders Shipped	99.8 % of the orders are perfect

3.4. PROBLEMS AND CAUSES

Taking into account the red values from performance indicators and also the warehouse process map, we have identified several problems regarding warehousing, related to space usage (based mostly on process map), inventory management, warehouse performance and order fulfilment (performance indicators), that are presented in the next table:

Table 4. **Problems and Causes**

CATEGORY	PROBLEMS	CAUSES
1. SPACE	- only 59.83% of the surface allocated to the storing of goods;	- the building had a different use before (it was a bakery facility).
	- excessive division of the space.	- the building had a different use before (it was a bakery facility).
2. INVENTORY MANAGEMENT	- a too high value of Days in Hand (41 days);	- the contracts with the suppliers aren't negotiated; the costs with the immobilisation of inventories aren't evaluated.
	- a too high value of Dock to Stock Time (0.75	- the firm doesn't use barcode readers and a

	hours).	barcode software.
3. WAREHOUSE PERFORMANCE	- a too small value of Orders per Hour;	- the excessive division of space; the firm doesn't use barcode readers and a barcode software.
	- a too small value of Items per Hour.	- the excessive division of space; the firm doesn't use barcode readers and a barcode software.
4. ORDER FULFILMENT	- the superior limit of Order Cycle Time is too high.	- the goods arrive late from the suppliers; the firm doesn't use barcode readers and a barcode software.

3.5. SOLUTIONS
3.5.1. Space
The main problem of the warehouse is the poor utilisation of space. It can be solved by breaking some walls so that to have only a room for storing the merchandise. One of the archives, the two halls and one of the toilets should be eliminated. The offices of the firm should be moved on one side of the warehouse, so that access to goods be direct. The current Office of the Director should be divided in two halves: one used by the director and the other by the accountant and moved on the left side of the warehouse. These modifications would result in a gain of 55.83 sq.m. There should be two main docks in the warehouse: one for receiving the products and one for delivering them. They should be situated on opposite sides of the warehouse. In this way, there will be a better access to all the products. Before making these modifications, the opinion of a construction engineer should be taken into account.
Another solution is related to the fact that there are multiple flows which intersect each other. One solution which would improve space utilisation is a new design of flows inside the warehouse – it looks like possible to establish one different entry and one different exit for each stored product category.

3.5.2. Inventory Management
"Dock to Stock Time" can be reduced by introducing portable barcode readers and a barcode software. The time for entering the products or for preparing them for delivery will be shortened also by solving the problem related to space. "Days on Hand" indicator will have a lower value if contracts with suppliers are renegotiated and if are kept only the ones who are able to deliver products fast. The firm should also use an ABC analysis in order to know what products to place near the exit dock.

3.5.3. Warehouse Performance
The problems related to warehouse performance can be solved by improving the space utilisation and by introducing portable barcode readers. We recommend a performance indicators continuous monitoring, in order to observe the improvements while they appear.

3.5.4. Order Fulfilment
Delivery problems can be solved by collaborating with suppliers that have the possibility to deliver merchandise fast or by investing in cars, and all that results from this investment (hiring a driver).
These solutions could be implemented, in our opinion, in about 3 months, and this is because the whole architecture of the building has to be changed. These solutions support the short and long-term objectives of S.C. TUDOR S.R.L.

4. CONCLUSIONS
The main solutions we propose in this article regarding warehouse management are performance indicators and process mapping. These two solutions complete each other. It is easier to establish key performance indicators for a warehouse after a process map was drawn, considering also other indicators used at international level. The process map is the helicopter view needed for establishing relevant performance indicators.
Performance indicators are useful for identifying the problems – red or abnormal values of the indicators are as a control system for a warehouse.
In order to solve the problems, we have used a very simple methodology: identify the causes of the problems and then try to diminish their impact or just eliminate the causes. It is a cause-effect approach, easy to be applied by any manager.
Warehouse performance measurement means, in our opinion, discovering the problems of the warehouse and solve them before is too late. It is a way to reduce costs by improving operations that take place in a warehouse, and having low costs is an essential feature of differentiating logistics firms. We applied the key performance indicators to a small company, but they can be calculated also for large firms. Even on a small scale, they helped us discover a lot of problems, out of which the poor utilisation of space was the essential one.

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