LOGISTICS OF THE INTERNAL PACKAGING IN MANUFACTURING COMPANY

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Abstract

This article is focused on the issue of internal packaging logistics in a manufacturing company. The object of the study is internal packaging management and intensification of the use of storage space. This article aims to analyze the current state of warehouses occupancy and used packaging and design solutions to increase utilization of internal packaging and more efficient use of warehouse space. On the basis of this analysis a set of recommendations was compiled, including the use of new internal packaging sizes, rules for the use of individual packaging sizes and implementation plan, including the necessary organizational and technical measures. The use of applied methodology in the manufacturing enterprises in general is also discussed.

Keywords: Internal logistics, packaging, reusable containers, warehouse, utilization

1. INTRODUCTION

Two conceptions could be distinguished speaking about internal logistics which is not as clearly established in literature as the logistics itself. The first concept is dealing with issues linked only to non-production items, for example, depending on what business you are in, the concept might include legal correspondence and contracts, travel tickets, samples for laboratory tests and other samples, supply of IT and other technical or non-technical equipment, marketing materials and other products which are used internally. On the other hand internal logistics could be perceived as the concept working with that part of logistics chain which is bounded by supply and distribution logistics. In this concept, also used in this paper, we deal mostly with the inbound flow of material, semi products, packaging and logistics of manufacturing processes.

1.1. Internal packaging

Packaging affects almost all of the cost items in supply chains. Packaging costs mainly refer to the packaging material costs and labor costs [1]. However, many aspects of logistics cost items are impacted by packaging too. For example, damages, cargo handling, control, and warehousing costs are dependent on quality and performance of packages, and on information carried by the packages. Risks are much determined by the packages being used and packaging design alters the physical density which would affect the freight rates, warehousing and handling cost directly. Costs can be saved usually by improving the efficiency and effectiveness of the packaging design [2]. Packaging and packages tends to fulfill various functions, such as [3]:

- Packages in transport and in cargo handling,
- Packaging the manufactured items, as one part of production logistics,
- Package as a means to implement standards to make materials handling and storing easier,
- Package as information carrier that it can act as a facilitator of logistics control functions,
- Package can help to trace items in supply chains,
- Package as a channel of marketing communication and promotion.

Packaging used in the company should be volume and weight efficient. It seems obvious but it is still overlooked by many parties. If the volume and weight relation is not designed well, there is poor utilization. The strength of standardized packaging is that it makes it easier to develop efficient logistics systems because

it places similar demands on transport and material-handling equipment. However, standardization may also lead to less adaptability with regard to change [4].

The use of plastic containers in the production processes where multiple flows of materials consolidate to a single flow at the time the final product is completed and the internal packaging used to transport parts and semi products to the internal customers creates a closed-loop system [5]. The cost associated with a reusable container system are cost of the containers themselves, cost of adapting handling devices to these special containers, and -in addition to the cost of transporting full containers- the cost of transporting empty containers back to their origin or to a central point where they are sorted, cleaned, inventoried and dispatched to the place of their next use [6]. Several studies are available and procedures were developed to determine fleet size to balance investment and containers shortage as well as simulation methods [7]. More reverse logistics issues were reviewed for example by team of De Brito [8].

1.2. Current status of internal packaging logistics in the company

Currently the company for in-house transport and storage of processed wires, which are the main semi product, use three sizes of KLT, see **Table 1**. Processed, cut wires, assembly or other semi products are transported to interim storage to be later transported to one of more than 300 workplaces in the company. Portfolio of stored semi product includes hundreds of various types and sizes. Not all of them are produced in one period. Some of them are produced only occasionally, some of them are produced permanently, according to customers' long term demands and requirements. In the context of internal packaging and linked logistics following basic issues could be defined:

1) KLT are not registered and efficiently managed.
2) Purchase of new KLT is not efficiently managed and is subject to acute shortage.
3) The quantity and size of purchased KLT are determined subjectively, based on experience and current acute need.
4) The rules of use of different sizes of KLT are not set.
5) Utilization of KLT is considered to be low.

Table 1 Structure of Internal Packaging KLT Portfolio

Structure of Internal Packaging KLT Portfolio		
KLT	**Dimensions (mm)**	**Quantity (Pcs)**
Big	600x400x250	7044
Low	600x400x120	5700
Small	400x300x120	2702
Total Quantity (Pcs)		**15446**

2. METHODICS AND DATA

Input data for the analysis was obtained by measuring the utilization of internal packaging within warehouses of semi products. During measurement KLT type (high, low, low) and one of 5 levels filling KLT (<10%, 10-25%, 25-50%, 50-75%, 75-100%) of the individual KLT was recorded. From a total of approximately 9009 KLT present in company during the measurements occupancy was measured at 2,624 of KLT (29%) stored in the warehouses of semi products. For the structure of sampled KLTs see **Table 2**. The aim of this study was to analyze the utilization of individual types of packaging and propose solutions to manage internal packaging that would allow an increase in the utilization of internal packaging KLT least to the level of 70% and a saving of storage capacity.

Table 2 Structure of Measured KLT

KLT type:	600x400x250mm	600x400x120mm	400x300x120mm	SUM
Measured:	1051	935	638	2624
Not Measured:	2241	3549	1315	7105
Measured (%)	32%	21%	33%	27%
Not Measured (%)	68%	79%	67%	73%
Total quantity (Pcs):	3292	4484	1953	9729
Measured Share:	37%	50%	22%	
Total Share of Type:	46%	37%	17%	

3. RESULTS

The performed measurements proved the assumption of relatively low utilization of internal packaging. The largest size of KLT (600x400x250 mm) was found to be most efficiently utilized packaging type. Interesting but not surprising founding was that the occupancy and thus utilization of used boxes decreases with its size. That means that the least utilized type of the internal packaging was the smallest KLT (400x300x120mm). The overall results of the measurement, frequencies within various levels of occupancy and average utilization of used packaging types are shown in **Table 3**. Unbalanced utilization of individual packaging sizes is mainly due to the nature of the products that are stored in them. Although the storage of each product rules are not laid down, workers, on the basis of experience, use for products with a bulky plastic cable-duct largest size KLT, for relatively long but not so volume consuming the medium box and for relatively small and few in number product the smallest box. Such products to fit large KLT usually mean only a fraction of production orders. In practice this means that even about 65% of large KLT is utilized to at least 50% the large amount of other boxes remain to be stored unfulfilled. The situation is the most alarming in the context of small size which average utilization was measured to be only little bit more than 30 %. In these small KLT boxes are often stored special wires about the size of only few centimeters and order size of only a few tens or hundreds of pieces. Most of the volume of KLT remains unused which means the storage capacity is wasted. As shown in **Table 2**, 70% of small KLT utilization is less than 25%. The overall average occupancy of all measured KLT reaches only about 45%. It could be said that when you increase the utilization of KLT for about 70% can get savings of up to about 30% of storage space.

Table 3 Utilization of Internal KLT

Utilization of Internal KLT							
Utilization Level/KLT Type	600x400x250mm		600x400x120mm		400x300x120mm		SUM
<10 %	6	1 %	50	5 %	203	32 %	259
10-25 %	214	20 %	363	39 %	244	38 %	821
25-50 %	348	33 %	322	34 %	117	18 %	787
50-75 %	334	32 %	159	17 %	52	8 %	545
75-100 %	149	14 %	41	4 %	22	3 %	212
Average Utilization (%)	59.71 %		44.60 %		31.47 %		45.26 %

About 15446 KLT packaging was used in the company at the moment of measurement, according to purchase records. The main idea of measures increasing the overall utilization is that content of less utilized boxes should be moved and stored in smaller boxes. As a sufficient desired level of capacity utilization two highest

levels were adopted. It means all the boxes which are utilized on at least 50 % (levels 50-75 %, 75-100 %) are considered to be well used. For those products that were previously stored in large KLT 600x400x120mm, whose workload was lower, it was proposed to use KLT size of 600x400x120mm. A similar measure was adopted for products previously stored in KLT dimensions 600x400x120 mm. For small-scale contract causing low utilization of KLT 400x300x120mm of less than 25% has been proposed to use the new mini-sized KLT and their location in a separate rack. Because that would measure necessitated adjustment of shelves used in the production halls, it was suggested alternative solution using KLT size 400x300x50, which are fully compatible with existing packaging - can be stored on itself and in existing shelves both in stores and in production and have half volume compared to hitherto smallest KLT. The effect of the proposed measures can be simulated via conversion made measurements, see **Table 3**.

Table 4 Simulated Utilization of Internal KLT after new size implementation

Simulated Utilization of Internal KLT (new size implementation)									
Utilization Level/KLT Type	600x400x250mm		600x400x120mm		400x300x120mm		400x300x50mm		SUM
<10%	0	0%	0	0%	0	0%	0	0%	0
10-25%	0	0%	0	0%	6	1%	0	0%	6
25-50%	0	0%	214	28%	363	47%	0	0%	577
50-75%	334	69%	507	67%	374	49%	0	0%	1215
75-100%	149	31%	41	5%	22	3%	614	100%	826
Average Utilization (%)	82.71%		65.11%		56.35%		100.00%		**73.96%**
Measured Share (%)	18%		29%		29%		23%		

Based on the measurements and calculations was proposed to expand the portfolio of internal packaging and add the new size. Given the current ratio of containers of different sizes, 3000 pieces of new size was proposed to buy to respect the resulting ratio of the size of packaging 20:30:30:20. By implementing the proposed measures 53% of the largest KLT (about 3955 pieces) and 19% (about 1,066 units) of low KLT will be released empty to be used in a future. In contrast, the measures entail buying about 2,000 pieces of KLT of dimensions 400x300x120 (recent smallest size). Total cost of the new packaging has been estimated at about 18500EUR.

Table 5 Original and estimated new storage need and savings

KLT Type	600x400x250mm	600x400x120mm	400x300x120mm	400x300x50mm	TOTAL
New Quantity	3089	4634	4634	3089	15446
Volume (m3 / Pc)	0.06	0.0288	0.0144	0.006	-
New Storage Need (m3)	185.352	133.4534	66.72672	18.5352	404.06736
Original Quantity	7044	5700	2702	0	15446
Original Storage Need (m3)	422.64	164.16	38.9088	0	625.7088
Difference (Pcs)	3955	1066	-1932	3089	0
Total Storage Saving (m3)					**221.64144**
Total Storage Saving (%)					**35%**

The aim of the study was not only to increase the utilization of internal packaging in the company but also to save the storage space in the warehouse. As the first target was met with the final utilization of more than 70 %, the second target was met with significant savings of space, in total more than 220 m^3 (35 % of original 625 m^3), see **Table 5**. The space saved is about to be used in the future to meet the demands of increasing volume of production which is expected to be around 20 % increase a year.

Several other measures were proposed to deal with registration, accounting, purchasing and rules for the use of internal packaging in the company. To ensure effective management of internal packaging, control their use and the possibility of collecting, analyzing and utilizing data on the flow of individual container is necessary to ensure traceability of individual containers and assign the appropriate packaging for each of the products. During the current state analysis was found that situations when the suitable size of the containers is not available at the workplace occurs quite lot. Workers are forced to use other containers, usually larger size, which is then less effectively used. Barcode labeling system is implemented in the company for some processes such as stocking materials, tracking production orders, identify some workplaces and stock positions, but not for the identification and tracking of internal packaging. Marking all internal packaging with a unique bar code will not only allow to track their accurate records, but also ensure the availability of data on the number of different types of packaging in the various workplaces, as well as the ability to check the accuracy of using various sizes of packaging for various products. Setting of restrictive conditions in the enterprise information system will be directly avoiding the possibility of the use of inadequate packaging without the authorization of the authorized person. When manipulating staff will try to check and stock the unmatched barcode and product packaging system will not allow stocking. An integral condition is also unambiguous assignment of appropriate size of packaging for each product. Recommendations for the purchase of containers mentioned above are based on the analysis of the existing portfolio of packaging. After identification of all products, assignment of container sizes and analysis of data on manufactured quantities of each product, estimation of the required quantity of each pack sizes can be refined. Data on need of various sizes and early detection of needs is currently missing for the effective purchase process. The new management system of internal packaging must also set the appropriate insurance and signal supply levels of packaging so as to prevent their depletion.

4. CONCLUSION

Internal logistics and management of internal packaging in a manufacturing company plays an important role, especially in the context of storage needs. Costs for storage of materials and sub products are a considerable cost factor. Not only for economic reasons we should attempt to lead the company to the highest possible utilization of internal packaging, as well as for their effective management. The aim of this study was to study the utilization of various types of packaging propose solutions to manage internal packaging that would allow an increase in the utilization of internal packaging at least to the level of 70% and serious saving of storage capacity. Implementation of the measures proposed will not require significant capital investment, but will help to significantly increase the utilization of storage space. The proposed measures achieved the increase in average occupancy of internal packaging from the original level of about 45% above the required 70%. Increasing utilization had a positive effect on the storage capacity needed to store semi products with the considerable saving of about 220 m3 (35% of original 625 m3). Although this study was just an initial task of long term logistics efforts in the company, the results are very promising and the future efforts will be focused on more in deep analysis of internal logistics. Further optimization efforts in this area should lead to the very efficient internal packaging management and maximal utilization of packaging, as it is the crucial issue not only because of storage needs in warehouse but especially because of work in progress of each workplace.

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