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Development of metallic rack packages for the metallurgical industry: Case Study

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Abstract
The companies that need partnership for pieces or components supply to compose their product, have concern with the quality of their packings. Nowadays, the packings have a fundamental part in the life and process of the product. The objective of this project was the development of industrial packings, like metallic racks, for machine components so that they propitiate improvements in transportation and storage. The metallic racks must assure the integrity of the components to be transported, ensuring their quality; especially they offer a system of easy fixation and handling of the components to ease the loading and unloading in the packings. The methodology consists in the following steps: recognition of the problem, detailing of the pieces and technical drawing; creation and technical drawing of the rack; layout and presentation; approval and final testing. Reduction trigged by the developed project was more than 50% of investments in packings, totaling almost US$2,000.00 per year and 10 thousand in 5 years.

Keywords: Metallic racks, Industrial packings, Design.

I. INTRODUCTION

The development of packings that ensure the integrity of the transported material is of paramount importance, and do not affects the quality issue only, but rather emerges as an important aggregator of value in the productive flow, assisting in system Lean Manufacturing, and reducing losses as: material movement, losses at stocktaking and rework or possible fixes.

The questioning of this case study is made up in the development of industrial packaging, like metal racks for machine components, aiming to provide improvements in transportation and storage by changing the way it carries these components when packed in wooden pallets, which were before fixed with tapes of metal or plastic. The study was done at the company Liebherr Cranes and machine tools Brazil Ltd., Located in Guaratinguetá city, São Paulo. The metal racks ensure the integrity of the components that are transported, by ensuring their quality, especially they offer a system of easy attachment and handling of components to facilitate loading and unloading in the packaging. The raw material of racks are obtained from other packagings (low cost), thereby decreasing the environmental liability.

The metal racks allow the logistics restructuring, that is, they must close a package of several components, in which each component has a purchase code, and with these kits it is generated only one for purchase.

II. LITERATURE REVIEW

The companies that need partnership for supply of parts or components to compose their product have concern with packings quality in which they are transported and stored. According to Ballou [1], logistics deals with all the move and storage activities, which facilitate the products flow since the acquisition point of the raw material up to the final consumption point, as well as the information flows which put the products in moving, in order to provide adequate service levels to customers at a reasonable cost.

Nowadays packaging plays a fundamental role in life and in the product process.

Despite all American rigor in the manufacture of packing, statistics show that the United States loses annually US$3 billion in transportation damage. In Brazil, although there is no data, it is known that prejudices are also considerable. Concerned about these losses, ABNT - Brazilian Technical Standards Association - has been studying the development of standards for packaging. The same concern made the IPT (technological research institute, in Portuguese) creates a group of engineering and Packaging Materials, in order to establish a certain coaching and information aiming to serve the packaging industry [2]. MESTRINER [3] says that packing historically

represented an important tool for the development of trade and for growth of cities. Contain, protect and facilitate transport are initial functions of packaging.

Packaging comes from human need and its limitations, according to Moura [4], the packaging development began with the man origin. It was created to facilitate transportation. The first inhabitants had storage needs especially food and water, vital for survival. It was then that primitive man started to use animal skull, hollow horns and large shells in fluid transportation and stowage of his harvests [5].

The analyzed packaging are the wooden pallets, commonly used in industry. Pallet is one of the main load elements. In operations among factories, the most commonly used pallet type is the returnable in an exchange scheme where the suppliers and users exchange with each other an equivalent number of pallets during routine distribution operations [4]. According to Baxter [6], the product development stages, in a company that has already characterized its objectives and strategies, overtake barriers of a consolidated product, in parallel with the product development strategies of the company.

To implement improvements in the industrial structure, it is necessary to boost the logistic system, which includes the supply of materials and components, the move and product control and support the sales effort of final products, up to placing the finished product to the consumer [2].

In the latter half of the 1990s, Brazil came out of a managed competition, with government intervention, for an open and globalized competition. During this period, the consumer had changed. Hence the supply chain (supplier, wholesaler and retailer), with the aim of optimizing its financial results, has been establishing information partnerships with each other, aiming the final customer satisfaction. Within this new context, one accentuates the focus on achieving profit on the capital that is invested.

Reverse logistics is the logistics area that deals with aspects about returns of product, packing or materials to their productive center. Previously this system worked very well in the beverage industry, with the bottles reuse. The product that reached the consumer was returned to its productive center so that the packing was reused and returned to the final consumer. The process was continuous and apparently ceased from the moment that the packings came to be disposable. Nowadays, companies encouraged by ISO 14000 and concerned with environmental management, began to recycle materials and disposable packing such as aluminum cans, plastic bottles and paperboard boxes, among others, that began to stand out as a raw material and no more as garbage.

III. METHODOLOGY

The initial stage is to recognize the problem, in which visits have been made to suppliers and production line, to observe the handling and main aspects of workers. After this step, it is executed the detailing of pieces in technical drawings, in which it was done a study of the main dimensions, weight and geometry of pieces in which they will be packaged. The racks are created from these data, these studies indicate the best position, fixing, optimization, and if there is stackability possibility.

After defining dimensions, weight and fixation, it is carried out creation and technical design of rack. At this stage, the elaboration of racks is begun. The 2 D drawings were handmade and then redesigned by using the auto CAD 2008 software; the 3D drawings, in the sketch-up 2008 software, both made in ISPIC research laboratory in FATEA. In the layout stage and presentation, it is made drawings in 3D using software like SolidWorks, to observe the appearance, viability and possible errors. The 3D drawing is made in real scale, which gives a better view of how it will look before it is ready. The software also makes a simulation of the fitting piece and the stack as in Figure 3. Then it is mounted a presentation sheet and submitted for approval.

After the project is approved, the models of racks are developed, tested, analyzed and, if it is need adjustments to the fitting of parts, in case there are skinned or scratches. Also in the test it is transported and stored the piece. If the rack is stacked, it is made two racks for verification.

The final stage is the one of elaboration of the final product, in which they are adjusted and tested. More racks are made, and the number of these racks is called by the number of pieces obtained in the month, ranging between four and six racks per piece. Visits to suppliers and to production line were made in order to observe the handling and main aspects of workers.

IV. RESULTS

Before the start of project 1, supports of valve block of the R-944 machine were transported in makeshift racks, fastened with plastic tapes and with cardboard shim, Figure 1 (a) and (b).

(a) **(b)**

Figure 1 (a) and (b) – Makeshift metal racks
Source: Authors

Figures 2 (a) and (b) show that the supports are transported and stored in specific racks and refrained from tapes and cardboard.

(a) **(b)**

Figure 2 (a) and (b) - New rack for supporting the valve block
Source: Authors

The second project deals with the planning and preparation of R-944 machine stirrups. Previously the pieces were stored on wooden pallets and secured with plastic tape and cardboard, Figure 3 (a) and (b).

(a) **(b)**

Figure 3 (a) and (b) - wooden pallets storing the machine R-944 stirrup
Source: Authors

In Figures 4 (a) and (b) it is noted the metal racks in an experimental model, even unpainted and without protective carpet, but with noticeable improvements both in appearance and in the organization of the stirrups, with parts positioned in a symmetric way, organized and fixed more simply.

(a) **(b)**

Figure 4 (a) and (b) - metallic rack for stirrups in experimentation

The changes evidence the costs reduction with the implementation of Racks. The life cycle of a rack is on average five years, the total cost of pallets in 5 years is about US$18,800.00, Tables 1 and 2.

Table 1: Comparison of number of pieces consumed each month and the pallet

	Stirrup		**Current guide**		**Covers**		**Fenders**		**Valve Block support**	
Machine	**Pieces number**	**Pallet quantity**	**Pieces number**	**Pallet quantity**	**Pieces number**	**Pallet quantity**	**Pieces number**	**Pallet quantity**	**Pieces number**	**Pallet quantity**
R-944	28	07	56	10	56	14	X	X	X	X
R-954	06	02	16	03	65	10	X	X	X	X
R-964	10	03	30	08	65	10	X	X	X	X
L-538	X	X	X	X	X	X	14	07	07	07
L-80	X	X	X	X	X	X	12	06	05	05
Monthly cost	US$54.00		US$94.50		US$153.00		US$58.50		US$54.00	
Annual cost	US$648.00		US$1134.75		US$1836.00		US$117.00		US$108.00	
Cost in 5 years	US$3240.00		US$5670.00		US$9180.00		US$585.00		US$540.00	

In each rack designed, the manufacturing cost was US$9,300.00, that is, savings of US$9,915.00 that is US$1,983.00 per year, Table 2.

Table 2: Comparison of the number of parts monthly consumed and manufacturing cost of racks

	Number of pieces	**Stirrup**	**Number of pieces**	**Chain guide**	**Number of pieces**	**Covers**	**Number of pieces**	**Fenders**	**Number of pieces**	**Support Manifold**
R-944	28	2 racks	56	6 racks	56	2 racks	X	X	07	2 racks
R-954	06	1 rack	16	2 racks	65	3 racks	X	X	05	2 racks
R-964	10	1 rack	30	2 racks	65	3 racks	X	X	X	X
L-538	X	X	X	X	X	X	14	3 racks	X	X
L-580	X	X	X	X	X	X	12	3 racks	X	X
Manufacturing cost		US$ 900		US$ 3,000		US$ 2,400		US$ 1,800		US$ 1,200

The reduction triggered by the developed project was more than 50% of investments in packings, totaling almost US$2,000.00 per year and 10 thousand in 5 years, these data are results of analysis of only five types of racks, nowadays there are more than 16 in use.

4.1 Projects in development

Figures 5 and 6 show, respectively, the technical drawing as well as the 3D drawing for storage of the wheels of machine A-924, also known as "sucateira", with storage capacity of 08 wheels per rack.

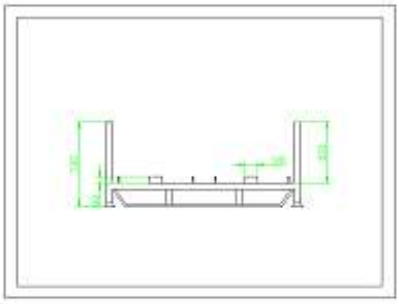

Figure 5 – Technical design of rack for wheels of machine A-924
Source: Authors

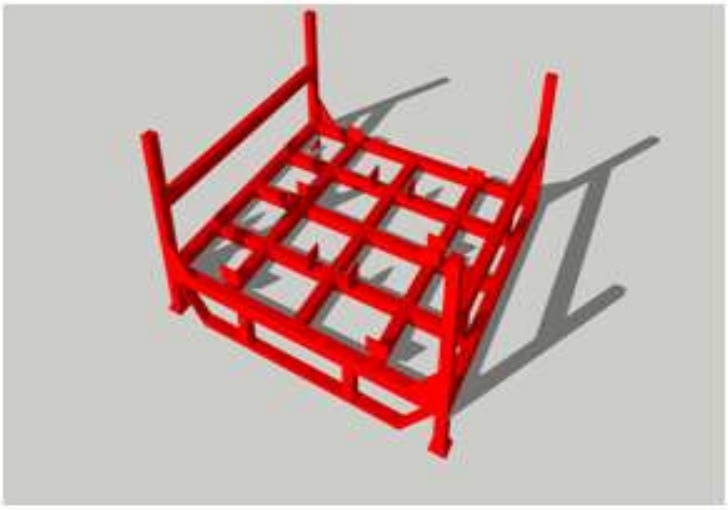

Figure 6 – 3D design of rack for wheels of machine A-924
Source: Authors

Figure 7 shows the sketch-up done with Auto Cad software of the metallic rack for wheels of machine A-924.

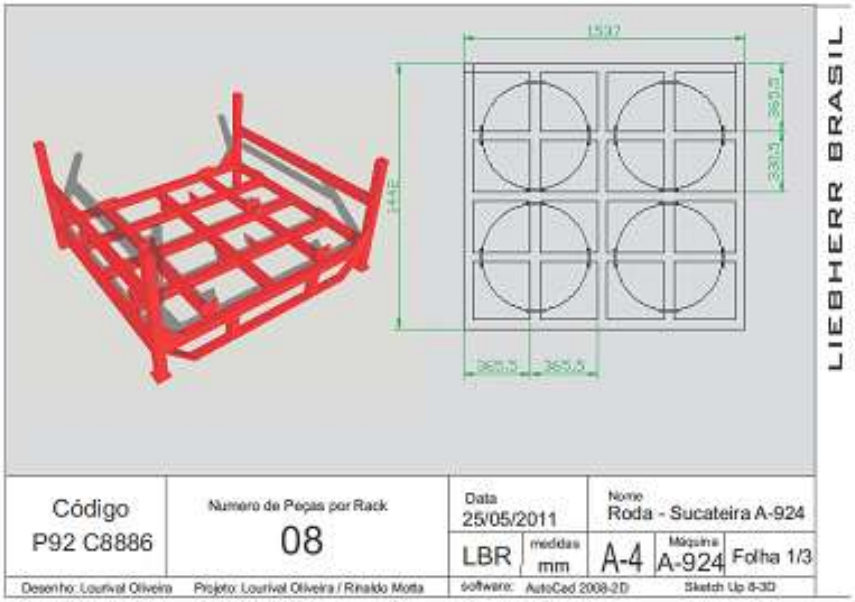

Figure 7 – Rack presentation sheet for wheels of machine A-924
Source: Authors

Figures 8, 9 and 10 show the technical design, 3D design and presentation sheet of metal rack of fenders of the machine loader - model L-580, whose application areas are in excavation, waste move, demolition and industry steel. The rack storage capacity is of 2 fenders.

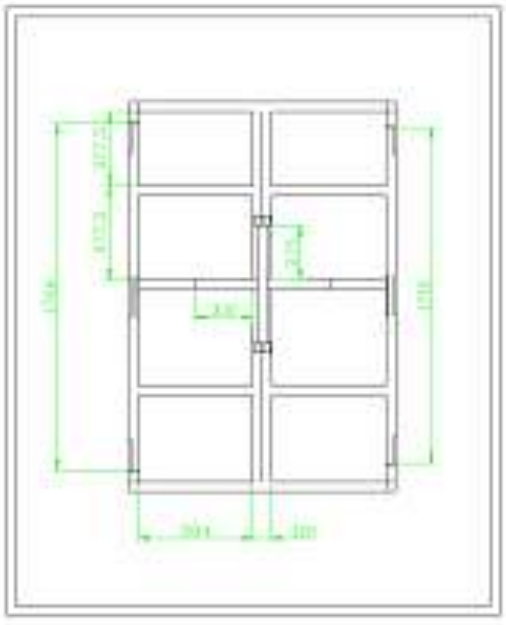

Figure 8 – Technical drawing of Rack for fenders of machine L-580
Source: Authors

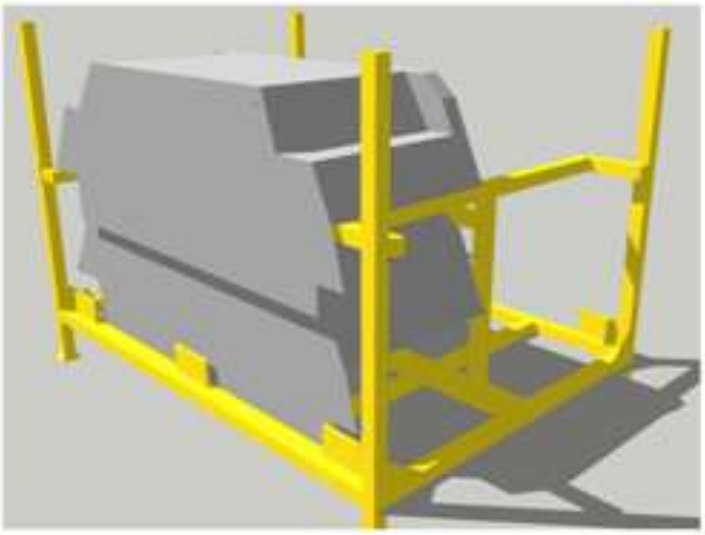

Figure 9 – 3D design of the rack for fenders of machine L-580
Source: Authors

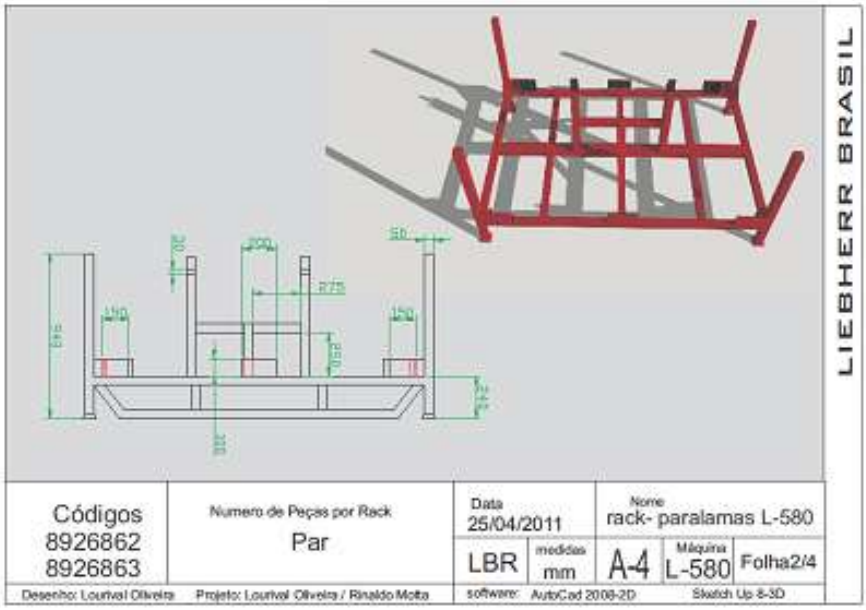

Figure 10 – Rack presentation sheet for fenders of machine L-580
Source: Authors

V. CONCLUSION

The article integrated areas such as logistics, production, materials, quality and manufacturing processes, adding value and reducing costs in the production process of the company portrayed in the case study.

The metal packagings, like racks, answer the storage and accommodation needs of product appropriately - verticalized. The verticalization of space presented a strategy of excellence of productivity gain, logistics accessibility and organizational quality.

In the packing and storage relationship, the project development ensured the integrity of parts, in addition to ally to the best way to stock, contributing a better appearance making the hangar clean and increasing the mobility flow of materials and information. The raw material used comes from materials from disposal, significantly decreasing the environmental liabilities of the company.

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