v. 2, n. 9, 2022

Journal of
Engineering
Research

THE PRODUCTION ENGINEER IN CIVIL CONSTRUCTION: THE IMPORTANCE OF THIS PROFESSIONAL IN A PRECAST CONCRETE INDUSTRY

Janyel Trevisol
Federal University of Santa Maria - UFSM
Santa Maria – RS – Brazil
ID Lattes: 8983775328654050

Abstract: Production engineering is the one that has basic knowledge of other engineering, but with an emphasis on process improvements and quality in order to always maximize productivity with minimum cost and waste. With the growth of the civil construction industry, mainly in the manufacture of precast concrete structures, there was a need to incorporate the knowledge and skills of the production engineer into its production chain. Thus, the present work aims to analyze the importance of the production engineer within a precast concrete industry and identify the activities that this professional can offer to reduce the incidence of industrial waste, improve production processes, ensure quality. products and increase productivity. The method used was action research, which allowed a detailed analysis of the processes and allowed the implementation of improvements to the company. As results of the work, it was possible to clearly evidence the benefits that the production engineering professional contributed to the organization such as process mapping, cost reduction, better visibility of the sectors, organization and cleaning, more efficient production control, analysis and waste reduction, improvement in internal logistics, waste management, assistance in production planning and control (PCP), optimization of physical space, increased productivity and quality assurance.
Keywords: Production Engineer, Civil Construction, Improvements, Productivity.

INTRODUCTION

The construction industry has evolved significantly over the last few years, mainly through the use of innovations and technologies in manufacturing processes in order to reduce waste and ensure the quality of the work. Industrialization in this area facilitated the incorporation of efficient work methods such as the use of prefabricated concrete, which provides numerous benefits to the work. The development of these prefabricated systems provides less waste, faster assembly of the structure, lower costs, cleaning and organization of the construction site, reduction of lead time. Even so, in civil construction, about 30% of the value of the work is waste resulting from poorly designed processes, breaks, rework, delay in transport, lack of labor or raw materials. Thus, due to the high complexity of processing and factors that influence the quality of prefabricated products, the production engineer is an essential part of ensuring the quality of products, as well as managing the instruments and manufacturing methods of this production chain.

The present work was carried out in a civil construction industry that manufactures precast concrete, which had high waste and losses in its manufacturing processes. This way, this work obtained the following research problem: What is the importance of the production engineer in the civil construction segment and what benefits can it offer in order to improve the production process and increase the company's productivity?

The general objective is to analyze the importance of the production engineer within a precast concrete industry and identify the activities that this professional can offer to reduce the incidence of industrial waste, improve production processes, ensure product quality and increase the productivity. As specific objectives, we can mention: identify the manufactured products, analyze the production processes, identify and analyze opportunities for improvement, carry out the implementation of the improvements, analyze the benefits of the same and its impact on the production chain.

This research is justified, as it can be used in the future as a study reference for

engineering students, and also to contribute to the company to improve its operational performance. In addition, it highlights the need for the production engineer in the civil construction segment, demonstrating some methodologies, techniques and tools that this professional uses in his activities, as well as denoting the advantages arising from the improvements applied in the manufacturing processes.

BIBLIOGRAPHIC REFERENCE

For Peinado and Graeml (2007), process mapping is a very useful tool and can have the following applications: improving the understanding of the work process, showing how the work must be done, creating a work standard or a rule of procedure.

According to Ceolin (2011), the term flowchart designates a graphical representation of a particular process or workflow. For Abreu and Trindade (2015) and Villar (2008), the flowchart makes it possible to analyze how the components of a system are connected and related, facilitates the location of deficiencies and provides a clear understanding of the proposed changes to existing systems.

According to the Toyota Production System, Slack (2009), waste can be defined as any activity that does not add value to the final product. According to Ohno (2006), there are seven types of waste that can be found within the production process: overproduction, waiting time, inventory, unnecessary transport, unnecessary movement, incorrect processing and defective products.

RESEARCH METHODOLOGY

The company where the study was carried out is located in Ijuí, Rio Grande do Sul, Brazil. The study was carried out through the development of the daily activities of the company's production engineer, who was responsible for the manufacture of precast concrete. In addition to quality tools, technical and specific knowledge of the professional, Excel software was used to prepare tables and flowcharts, in addition to Microsoft Word to prepare documents and records.

In carrying out this work, an action research approach was followed, in which the researcher and the work team cooperate and participate in solving the problem, through the collection of information, monitoring of activities, documentary research, observation activities, informal meetings and, thus, formulate concepts between researcher and team.

First, activities were monitored to collect data and identify existing waste and analyze opportunities for improvement. Photographic records were also used to make a comparison between the current manufacturing environment and after the implementation of the improvements.

The technique of direct observation in the factory environment was also used to monitor the activities and verify the manufacturing process of the products and informal interviews were carried out with some employees to obtain more detailed information.

Subsequently, the improvements were implemented according to a pre-elaborated strategic plan and, then, it was possible to compare the before and after of the improvements made, extolling the importance of the production engineer in civil construction.

RESULTS

The company's structure allows the manufacture of several products, which can be customized according to the customers' needs. This flexibility is possible through shapes and templates that can be adjusted, providing variations in the dimensions of

the products. The products are divided into categories such as panels, beams, pillars, slabs and joists.

Based on the Toyota Production System, the following wastes were identified in the company:

- Process: there is no Standard Operating Procedure (SOP) that instructs employees on how to perform manufacturing activities and processes. Thus, the products do not have a standard and many end up being reworked or discarded due to operational errors.

- Transport: there are no aisles for transporting materials and products. This transport takes place through a monorail and an electric hoist that carry out the transport slowly. Another important factor is regarding the transport of some boards or parts that are very heavy and are lifted manually, as they are out of the way of the hoist and monorail, generating ergonomic and accident risks.

- Inventory: there is an inventory of finished and in-process products. This is due to errors in the projects or an incorrect production schedule. In addition, there is a stock of obsolete material within the manufacturing environment, generating several problems in the production chain.

- Movement: there is a lot of unnecessary movement in the company, usually to look for material or tools, to go to the engineering sector to solve project doubts, or to carry out reworks.

- Defective products: this occurs due to errors in the projects, excess of materials, tools, equipment and in-process inventory, lack of SOPs and employee training.

- Waiting time: the production schedule often sends some incorrect Manufacturing Orders to the factory, that is, sometimes walls are produced that would be the last to be assembled at the construction site, while the first ones have not yet been produced.

The activities carried out by the production engineer are of fundamental importance to the company and directly impact costs and productivity. Such activities are described below.

Process mapping

The company has a variety of products, however, the manufacturing processes remain the same, with only some differences along the processing steps. Basically, all products have the following process mapping:

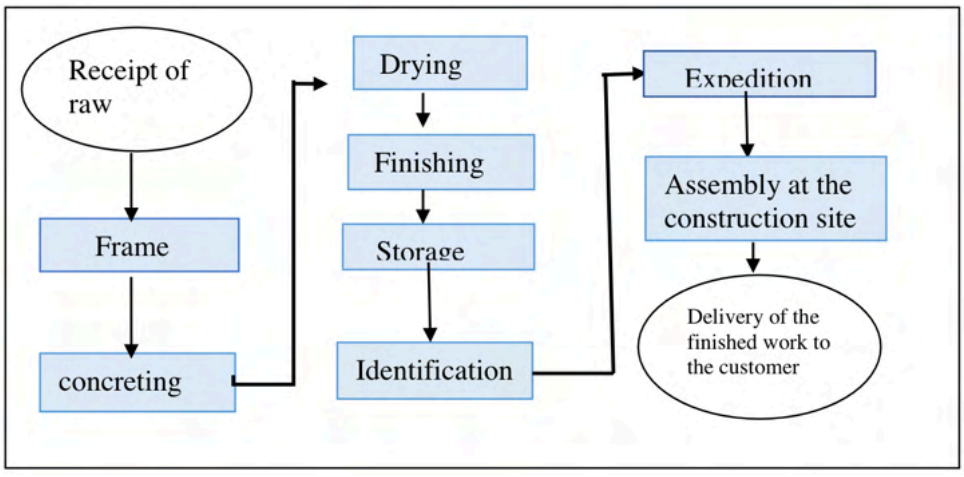

Figure 1 – Macroflowchart of precast concrete fabrication.

Source: Prepared by the author (2018).

Manufacturing processing involves eight main processes, and starts manufacturing upon receipt of raw materials and ends the production cycle upon delivery of the finished work to the customer. To further map the manufacturing steps, it would be interesting to deepen the analysis of each manufacturing process, drawing up microflowcharts of each process to identify waste and improvements that can be implemented.

Cleaning and organization of sectors

The company has two ways of manufacturing wall or slab panels, which are used almost daily and are where most of the concreting operational processes are concentrated. However, the old molds or leftover materials and waste were placed under these molds, generating accumulation of materials, dirt, bad odors, the possibility of the proliferation of animals and physical risks to employees.

Sector cleaning was carried out and employees in the sector were instructed to correctly dispose of the materials, that is, dispose of them directly in the metal trash so that the correct destination is given.

The cleaning of waste provided optimization of physical space, clarity of the sector, improvement in the internal flow, improved visibility of the sector, provided speed and ease to identify materials and greater safety for employees.

In the pillars and beams manufacturing area, there was also an accumulation of broken parts, scattered materials, discarded tools, various residues and dirt, in addition to usable materials that are lost.

It is possible to verify that there was no organization and cleaning, as there were wood residues scattered around the area, in addition to a wooden mold thrown on the floor in front of the circular saw, obstructing space and hindering the flow, generating physical risks for employees. Another important factor was the circular saw, which was located in a sector where it is little used.

From these problems verified, the cleaning and organization of the sector was carried out because, in order to produce properly and with quality, the work environment must be organized and adequate for employees to perform their activities correctly. Obsolete molds were removed from the industry and everyday molds were relocated to avoid the possibility of damage. The circular saw was relocated where there is a greater need for wood cuts, reducing the distances traveled by employees.

Organization of planks of pillar shapes

The shapes of beams and pillars are flexible and their width can be changed by changing the planks. However, these boards are heavy and need to be correctly placed to facilitate handling. However, they were laid out on the floor, without organization and generating risks of material damage or accidents to employees.

In addition, if it is necessary to use the board that is below all the others, the employees will need to remove the ones on top until they reach the desired one. With this, a metallic shelf was created to place these boards neatly.

This support made it possible to separate the boards according to their widths, in addition to allowing them to be easily identified. The space was also optimized allowing for an improvement in the flow of people and materials. In addition, the place where the support was structured allows the use of an electric hoist to assist in lifting the board and facilitate operation, reducing ergonomic damage.

Figure 2 – Remains of materials next to the Metallurgical.

Source: Prepared by the author (2018).

Figure 3 – Cleaning the area next to the Metallurgical.

Source: Prepared by the author (2018).

Figure 4 – Disorganization in the beam and pillar manufacturing sector.

Source: Prepared by the author (2018).

Figure 5 – Cleaning of the sector and removal of the circular saw.

Source: Prepared by the author (2018).

Figure 6 – Incorrect stacking of shape planks.

Source: Prepared by the author (2018).

Figure 7 - Support for placing boards.

Source: Prepared by the author (2018).

Assistance in production planning and control (PCP)

The company does not have an ERP system for production planning and control. Only one professional who designs the products and sends them to the factory in the form of a Manufacturing Order (OF). In addition to the projects, a document with the weekly schedule, written manually, is sent to the production manager.

The schedule is based on the volume of concreting that each product needs to be concreted and not on the type of product being produced, which often ends up compromising compliance with this schedule. This is due to the fact that many products are made to measure and therefore require different setup times in the form.

To solve this programming problem, firstly, a chronoanalysis of the process of preparing and configuring the shapes of panels and slabs was carried out. The preparation times of several products were measured, measuring separately the times of fixing the bars to the forms, cutting times, times for placing and fixing pipes, times for placing the templates of walls and doors, times for placing the metal frame.

Through these time measurements and data analysis, it was possible to prepare the production schedule with greater assertiveness, ensuring quality and reducing industrial costs.

Analysis and restructuring of the layout in the welding sector

The welding sector is very important for the elaboration of materials and parts to be used in the framework of the metallic structure of the products and parts used on the construction site. However, in addition to having a welding machine in the room, there are also many other equipment, materials, parts and tools that are allocated in the sector.

Thus, the room that would be the welding process ends up holding many other materials, generating disorganization, excess materials, space obstruction, safety risk, difficulty finding materials and tools, risk of damage, breakage and loss of materials and tools. Through the analysis of the problems highlighted, several improvements were elaborated to be implemented.

Among the improvements made in the sector, the following stand out: development of a process line; the grinding wheel was fixed on another bench on the other side of the room to stay away from the welding machine to avoid accident risks; a shadow board was created to keep the tools organized and to facilitate their control; the new arrangement of the machines allowed greater lighting; the area was cleaned by removing materials, tools and equipment that are not used in this area; optimization and clearing of the area generating more available space; obsolete materials were discarded; benches were cleaned; a structure was made on the wall to hang the lifting straps.

Possibility of future work

In addition to all the activities carried out in the company, some future activities were also left open that will also contribute positively to the company. Among such future activities, we highlight the elaboration of a 5S program, the use of a program of ideas to instigate the involvement and participation of all employees, use the kaizen system, analyze the factory layout and seek alternatives to streamline internal logistics, perform preventive maintenance of machines and equipment, verify the feasibility of implementing an ERP system, create a warehouse of all materials and raw materials with efficient control, carry out periodic training on topics relevant to the organization.

Figure 8 – Disorganization in the welding sector.

Source: Prepared by the author (2018).

Figure 9 - Reorganization of the welding sector.

Source: Prepared by the author (2018).

CONCLUSION

It can be seen through the present work that the production engineer is very important for any type of industry, especially in the area of civil construction, because through his skills and abilities, he allows to identify waste and opportunities for improvement where they were imperceptible in the eyes of their own. managers.

This work achieved all its objectives, as the product families were identified, the production processes were analyzed, opportunities for improvement were analyzed and implemented, in addition to verifying and pointing out their benefits to the organization. Still, it was also found that the production engineer is a key piece for the improvement of organizations with regard to processes and products.

The production engineer has different qualities, as he understands the processes in a systemic way and, from this, he is able to delve into the details of each process. Thus, these skills of this professional provide many benefits to companies and industries such as waste reduction, cost reduction, process improvement, quality assurance, increased safety, greater organization and cleanliness, increased productivity, optimization of physical space, improvement in control and management of materials, improvement in production flows.

The work carried out in the company was of great importance to it, especially because it was the first time that the knowledge of the production engineering professional was used in the factory and it contributed positively in a significant way to the increase in productivity. and organization thereof.

REFERENCES

ABREU, E.L.; TRINDADE, E.L.G. **Utilização do fluxograma e da ferramenta DMAIC em uma fábrica de polpas de frutas localizada no vale do São Francisco.** Encontro Nacional de Engenharia de Produção - Enegep, n. 35. Fortaleza, 2015.

CEOLIN, E. **Conceito: Fluxograma**. Ciências Sociais. Ed. Trabalhos feitos, 2011.

OHNO, T. **Sistema Toyota de Produção: Além da produção em larga escala**. Porto Alegre: Ed. Bookman, 2006.

PEINADO, J.; GRAEML, A. **Administração da Produção: Operações industriais e de serviços.** UTFPR. Curitiba: UnicenP, 2007.

SLACK, N. **Administração da produção**. 3ª Ed. São Paulo: Atlas, 2009;

VILLAR, A.M.; SILVA, L.M.F.; NOBREGA, M.M. **Planejamento, programação e controle da produção.** João Pessoa: Editora universitária da UFPB, 2008.