PROPOSAL OF ACTIVITIES THAT FACILITATE WORK IN ORDER TO AVOID WORKFLOW INTERRUPTIONS CAUSED BY MAKING-DO

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ABSTRACT

Production planning and control play an important role in the stabilization of the workflow. However, in several Brazilian companies the production management staff does not get properly involved in the careful analysis of the tasks that need to be planned. This may cause discontinuities in production.

One way of avoiding this problem is the implementation of activities that facilitate the work, i.e. those that prevent or minimize stoppages or interruptions throughout the production process. The aim of this paper was to propose activities that facilitate work in order to avoid workflow interruptions caused by making-do waste.

This investigation was based on a case study on the planning and control process of a refurbishment project in the passenger terminal of an international airport. The main sources of evidence were: analysis of documents, analysis of project data, direct observations, and development of process maps.

One of the main results was the categorization of the activities that facilitate work in terms of reduction of waste. The main categories identified were: Space Conflict, Work preparation, Sequencing, Access and Design.

KEYWORDS

Process, waste, workflow, interruption, activities that facilitate the work, constraint analysis, lean construction.

INTRODUCTION

Construction usually involves the production of a a unique product, involving several stages, such as design, planning and execution. Several targets are normally established in those stages, such as buildability, productivity, quality and time reliability, and cost reduction.

There are several studies in the literature that have investigated ways of improving the planning and control process, or identified different types of waste. However, there are only a few studies that have proposed activities to reduce waste during the implementation of the planning and control process.

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Koskela (2004, p.3) define making-do "as a waste refers to a situation where a task is started without all standard inputs, or the execution of a task is continued although the availability of at least one standard input has ceased. The term input refers not only to materials, but to all other inputs such as machinery, tools, personnel, external conditions, instructions, etc."

Ronen (1992) apud Koskela (2004, p.2), "analyzed the causes and impacts of the phenomenon of making-do as a generic issue in operations management". Ronen (1992) "did not define making-do but rather the ideal situation where no making-do is required: the complete kit. A complete kit is, according to Ronen (1992), the set of components, drawings documents and information needed to complete a given assembly or a process. Thus, he suggests that work should not start until all the items required for completion of the job are available", in order to avoid interruptions in the workflow.

Santos (2004, p.91) defines extra-planning activities or activities that facilitate the work as "those that prevent or minimize stoppages, or interruptions throughout the production process. Treville and Antonakis (2006) suggested the expression work facilitation, which is similar to what Santos (2004) defines as extra-planning activities. These activities can be defined as activities that facilitate the work, help managers to anticipate and schedule the resources needed for the implementation of the tasks. They can be incorporated into the process or be a support activity. These activities are strongly related with making-do waste (Koskela, 2004) and should be able to prevent this type of waste. In some cases, those activities are used in the setting up of a task.When those activities are not carried out, the likelihood of existing a constraint tends to increase.

The aim of this paper was to propose activities that facilitate the work to avoid interruptions in the work flow resulted from the wastes of the type making-do.

LITERATURE REVIEW

PLANNING AND CONTROL OF WORKS TO REDUCE WASTES

Waste can be eliminated when constraints are removed (Goldratt 1984). Many problems can be solved when developing plans to remove the constraints. The Last Planner System™ (LPS) involves the process of identifying and removing constraints for the tasks planned at the medium-term level. As the focus of LPS in on managsng flows, it contributes for process stability and for the reliability of production planning and control (Ballard and Howell 1998).

Several case studies of LPS implementation have been reported, indicating a high degree of success in terms of implementation and effectiveness. According Sacks et al. (2010), the LPS implementation has contributed to reduce waste in construction projects. This is possible due to the reduction of variation, and improved coordination and workflow.

According Porwal et al. (2012, p.3), the LPS training and pull planning by senior management and site crew are crucial to its success. However, if there are delays in the implementation of the LPS the success of the system can be compromised (Porwal et al. 2012, Koskenvesa and Koskela 2012).

At the middle term planning level people can identify the constraints. These can be avoided with the use of activities that facilitate the work. This allows the improvement of the process to anticipate an activity or remove a constraint. When the

constraint is removed, the production protections against the uncertainties are associated (Ballard and Howell 1998). To Ballard and Howell (1998), the LPS define what will be done, adapting to what should be done and checking the constraints of what can be done.

The failures in the team's commitment to carry out what was planned must to be investigated, so it won´t occur again (Bhatla and Leite 2012). It´s necessary not only to remove the constraints, but to anticipate them.

IMPLEMENTATION OF ACTIVITIES THAT FACILITATE WORK

The activities that do not add value to the process must be identified. These activities are divided into supportive and unproductive activities, such as, for instance set-up activities (Santos et al., 2012). This activity is necessary, but does not add value to the process. By contrast, unproductive activities are interruptions due to weather conditions, unnecessary handling, demolition and reconstruction of defective work, and search for tools and materials that could have been pre-planned (Kalsaas 2010). These activities lead to discontinuities in the flow process, resulting in decreased productivity, poor quality and waste (Santos 2004), which could be reduced by improving planning.

Treville and Antonakis (2006) emphasize the importance of analyzing the flow of activities, investigating where wastes can be reduced or eliminated. According Koskela (1992), one of the major problems is that the construction companies do not use improvements in the production process of construction because their view of the production processes is too conventional. Companies do not see activities as flows. So, they do not look for solutions to reduce or eliminate waste.

Ohno (1997) emphasized the need to remove waste in the whole process, from the beginning, when the client makes the request, until the moment in which the product is delivered. Waste should be identified and reduced or eliminated (Treville and Antonakis 2006). Goldratt (1984) stated that the efficiency of a factory is not connected to its modern equipment but the proper management.

It is essential to control flows, in order to avoid wasting time, quality or misuse of resources (Santos 2004). According to Ohno (1997), these are the foundations of the Toyota Production System (STP). The same author pointed out that the worst kind of waste is overproduction, because it is in the human nature to feel safer when envisioning larger stocks. However, to keep large stocks must be made larger disbursements than keeping in stock just enough. Ohno (1997) also suggested that efficiency improvement must occur at all levels of work. The production capacity of a is defined by Ohno (1997) as the work produced plus waste.

Nevertheless, wastes are intrinsic to any production process. It is important for the professional in charge of production management to look for causes of waste and act effectively, in an attempt to avoid them and reduce them as much as possible (Santos and Heineck 2010).

It is observed that discontinuities commonly are logged when unproductive times are investigated because they consume time and cost, and eventually result in compromising quality or environmental impacts. Thus, several studies to quantify the unproductive time on construction sites, including studies, research of Kalsaas (2010) where these waste by waiting can be related to project management, production planning and designs.

Rivas et al. (2011) also cover the waste by waiting, among others cited by the authors in research carried out in Chile. The five categories account for unproductive time and productivity waste are expected, transport, slow pace of work, badly executed work and rework. In the research, it is said that the first category "wait" for lack of material, equipment and interpretation of design, corresponds to 59 the total time wasted. These are instances that depend on managerial attitudes to be avoided and lead to problems due to low productivity, resulting from poorly prepared plans.

In general, there is a great potential to improve productivity in the short term, only with a well studied and analyzed into details, to the level of production planning. Even before the production planning, the planning phase of the design process, that due to the large flow of information required, can present activities that add value to the product or not. Therefore, several researchers, such as Yoders (2009), studying the application of information technology in the project and, with this, you can promote improvements in the process.

Gehbauer (2004) draws attention to the fact that only 20% of the tasks performed by workers are considered productive activities and stresses that the employees have learned to look like are always occupied, in order to avoid problems with his superiors. The author continues by stating that, often, there are no opportunities for workers to carry out productive activities because often there is a lack of plans and work instructions.

When Koskela (2004) defines making-do, he adds more one category of waste proposals by Ohno. Ronen (1992) apud Koskela (2004, p. 3) “mentions three basic causes of making-do: the efficiency syndrome, the pressure for an immediate response and improper division into levels of assembly”. Thus according to Ronen (1992) apud (Koskela (2004, p.3) “the efficiency syndrome is the urge to have the resources utilized as much as possible”.

Koskela (2004) says that “the pressure for an immediate response provides a less straightforward case. One motivation lies in the belief that by starting early, even if with an incomplete kit, the task will also be completed earlier. Another motivation is to start the work just for getting the job. On the other hand, if the customer does not trust the supplier, the only way of ensuring that his order is delivered at due time is to require that the work is started immediately.” Treville and Antonakis (2006) claim that the quantity of inputs used is reduced when the principles of lean construction are assimilated into labor.

Kalsaas (2010) highlights unproductive activities such as transportation, waiting and unnecessary movement. These contain obvious aspects and can be measured in terms of time. Although obvious, as well as overproduction, these actions result in waste and are frequent in construction.

Liker and Meier (2008) emphasize the importance of the key points for the completion of the work, in order to contribute to a proper training, productivity gains and continuity of work. These key points contribute to the improvement of the process to identify examples of good practice in the sector in past experiences. The authors accentuate the need to analyze the activities for further subdividing them into smaller plots suitable for a training situation. This analysis must be made so as to ensure that all necessary activities are performed.

For Liker and Meier (2008), identifying those activities can help to identify potential problems or constraints, and anticipate them, developing a key point that prevents the occurrence of failure.

It is widely known that the technologies adopted in most construction sites are fairly traditional. In this way, to get these good practices as key points (Liker and Meier 2008), work facilitation (Treville and Antonakis 2006) or extra-planning activities (Santos 2004), it is necessary to ensure that the implementation of the activities to be more secure, productive, with quality, on time and costs.

Santos (2004) proposes the following categories for extra-planning activities: (i) access, (ii) design, (iii) work preparation, (iv) work conference, (v) space conflict, (vi) sequencing, (vii) worker's protection, (viii) process protection, and (ix) work planning.

METHODOLOGY

The research strategy adopted in this investigation was a case study. The project was extremely complex, with interference from multiple agents external to the project, such as internal and external clients, users, contractor and hired, and long-term duration, as noted in the study Gil et al. (2008).

In addition, the project was executed in an area of high population density. The impacts caused by the work will be large, such as noise; stir in material and workmanship; demobilization of commercial stores, parking lots, bus stops and places of shipments for aircraft. It took well-designed planning and projects.

Data collection tools were daily observations of the renovation project, analysis of documents, projects, queries the database with examples of activities that facilitate the preparation of spreadsheets, participation in meetings and unstructured interviews with those responsible for projects, and for work planning. After data collection and listing of the activities necessary for the realization of the project have been identified the moments of making-do and waste time. Then process maps were developed to include activities that facilitated the work and minimize waste. In the central body of the maps were included the activities that add or not value to the product and this activities that were of the constructive process. On the sides of the map were placed the activities that facilitate the work. These are placed near time that can cause wastes.

To identify the activities that facilitate the work, it was applied the model of Santos (2004). They were still considered the removing of the constraints and the anticipation of these activities. The identified activities were divided into categories. With these measures you can reduce the making-do and the waste of time.

RESULTS

To meet the proposed objective, it follows the development of a plan for the implementation of the various stages of rebuilding. The phases of work were divided to that there were the optimization of different services, bringing comfort and safety to users and workers.

The goal was to compromise as the operational functioning of the airport and ensure the maintenance of at least 50% of the services in each stage of rebuilding. The steps were set in several meetings with the various professionals in airport work

routine, such as representatives of commercial, legal, security, operations and maintenance sector.

In the case study has been studied the check-in area, located on the first floor of the airport. It was suggested a executive sequence in parallel to that occurs on the ground floor, looking for cause with common work areas were isolated at the same time, grouping work areas in common to be isolated at the same time. This minimized inconveniences and interferences in the operation of the airport. This step was divided into two phases (Figure 1).

The search followed the first part (in green). In this research were performed the following activities: modernization of the check-in counters, adequacy of monitors above each check-in counter, adequacy of fitness mats and scales of the check-in counters and runway construction, modernization of the information counters, replacement of the ceramic coating floor. In the check-in area was removed 50% existing counters. Only in the next step is to be taken from the other counters. This was done for not to interrupt the operation of the area.

During the research, the rebuilding had not yet been initiated and the technical services did not brought great complexity. The concern was due to the fact that it is an area with large flow of people and the need to maintain the operational readiness of the airport. The execution plan was designed to minimize the inconvenience due to work.

In this paper it is presented the process flowchart prepared for the constructive process of the replacement of the ceramic coating, containing the insertion of activities that facilitate the work. These activities were raised from the application of the tools listed in the methodology. Then the researches realize a brainstorming to elaborate the final listing of activities. After, they divided these activities in their categories (Figures 2 e 3).

To prepare the flowchart of the process, the researchers have looked at what the activities were already doing part of the construction process and which the activities facilitated the process (Treville and Antonakis 2006) and then they can be inserted in it. A Figure 3 presents the activities that facilitate the work and the categories in which they fall: Space conflit, Work preparation, Sequencing, Acess and Design (Santos 2004). The researchers check in the flowchart that no activity that facilitates the work was incorporated into the executive process.

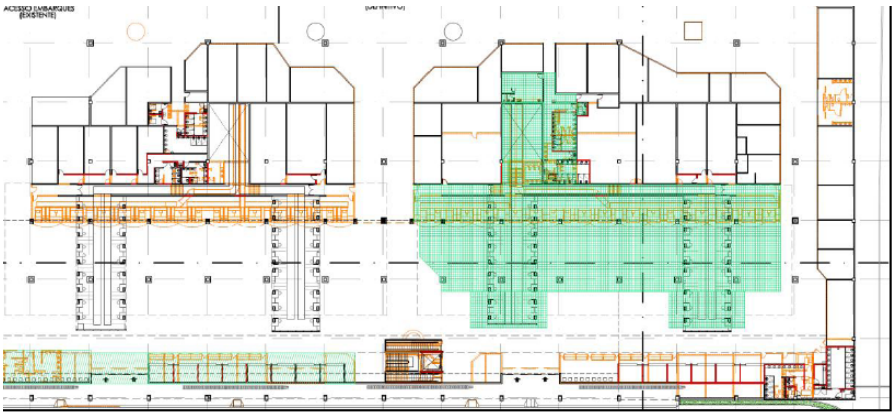

Figure 1: Work Plan - 1 Floor - check-in area

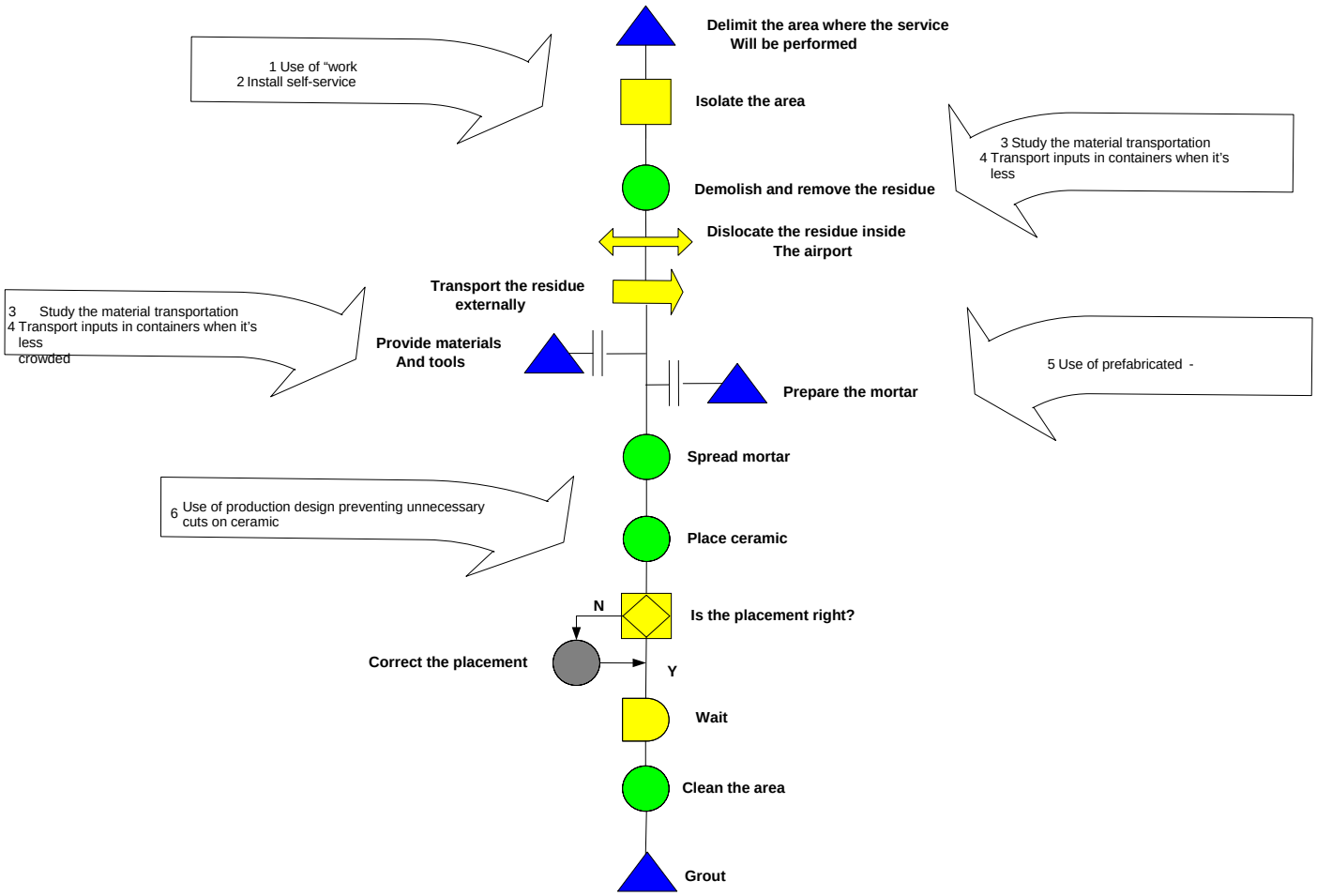

Figure 2: Flowchart of the replacement of ceramic coating in the construction process

In the category of Access, it was observed that the movement of people and materials should be better designed to eliminate or minimize waste of movement and transport. The work flow was discontinuous and often took place overlays (Poswal et al. 2012, Koskenvesa and Koskela 2012). This undermined the safety of workers and passengers. To reduce the making-do (Koskela 2004), it was suggested to the team of work the creation "work islands". This island should isolate the area with partitions. This gave a nice and clean look of the area, in addition to reducing distances to be travelled and create an environment of production cell.

For the Project category, the use of production projects is necessary to facilitate the implementation of the process (pre-planning) (Kalsaas 2010), primarily in terms of definition of position and cutting of ceramic coating parts. This avoids failures in executive process. This type of category helps to reduce the waste of the processing itself (Ohno 1997). Work preparation is a category exemplified through the use of prefabricated mortar or the disposal of demolition materials properly (Kalsaas 2010). It contributed to the reduction of waste in the processing itself, by defective products, by overproduction and due to making-do (Ohno 1997, Koskela 2004). In the case of residue, these inputs should be packaged appropriately so as not to cause inconvenience to users. Examples of the Space conflict category were identified because the rebuilding happened with the airport in operation. To minimize the problems caused (Poswal et al. 2012, Koskenvesa and Koskela 2012), it was suggested to the responsible team for the installation of self care totems. These totems aim to vent the check-in counters. This kind of suggestion aimed to reduce waste of time by waiting and agglomeration of people and baggage (material stock) (Kalsaas 2010). In this case, passengers would use the totem only to dispatch their baggage.

N	Extra-planning Activities / Categories	Access	Design	Work preparation	Work conference	Space conflict	Sequencing	Worker's protection	Process protection	Work planning
		1	2	3	4	5	6	7	8	9
1	Use of "work islands"	X				X				
2	Install self-service totems	X				X				
3	Study the material transportation flow			X		X				
4	Transport inputs in containers when it's less crowded			X		X				
5	Use of prefabricated mortar Utilizar argamassa pré-fabricada			X		X	X			
6	Use of production design preventing unnecessary cuts on ceramic coating		X				X			

Figure 3: List of activities that facilitate the work and their categories

The Sequencing category is related with the production order of a given process. By reducing this production order as, for example, by using prefabricated mortar, you can ensure the continuity of the process and avoid the waste of time (Kalsaas 2010). Another example was the do not use of production project, because this project stimulates the constructibility, to avoid time stopped and ensure the sequencing process.

No examples of waste of time or making-do were identified for the following categories of activities that facilitate the work: Worker's protection, Process protection, and Work planning.

CONCLUSIONS

It is important to draw attention to the fact that the extra-planning activities must be inserted in the beginning of the constructive process (anticipating activity) or before its use which is inserted into the flow (constraint removal). If the activity is not included in the process in time, it will result in a constraint that must be removed to provide the work continuity.

It was observed, therefore, that there are gaps in the planning and the extra-planning activities can be incorporated into the construction process researched in order to avoid time waste and the phenomenon of making-do.

The identified activities were divided into categories. They are examples of activities that contribute to the continuous improvement of the process. With these measures you can reduce the making-do and the waste of time. In the research, it will follow the implementation of activities in the field to measure the reduction of waste of time.

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