WHY DOES PRODUCTION MANAGEMENT FAIL IN CONSTRUCTION?

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ABSTRACT: Production Management in construction is blamed for project failures for a variety of different reasons. Thus, the goal of this paper is to analyze whether widespread failures have happened and in case, why. To start, evidence for a generic failure of production management is forwarded. Then, a number of relevant causes are discussed. Firstly, we discuss if construction lacks its own theory, or if it has enough theories but they are badly implemented. Secondly, the importance of a production system for each construction project is examined. Thirdly, some production management methods are presented, such as activity-based and location-based types of scheduling, as well as how the industry has been using them to manage its projects. Fourthly, the use of push and pull systems are also discussed. Fifthly, the human aspects are considered, especially the commitment of the workforce to the project. Learning capacity and opportunities for continuous improvement are also analyzed.

Keywords – Methods, Production Management, Production Systems, Project Failures, Theory.

1. INTRODUCTION

First of all we have to inquire if Production Management does really fail. Doing a rough search in the literature, it can be observed that Production Management is blamed for construction failures for a variety of reasons. Firstly, some authors point out the lack of specific theory for construction, or even a bad implementation of the few existent theories, as the cause of some project failures (Koskela & Howell, 2002). Secondly, others (Ballard & Howell, 1998, Bashford et al., 2005) argue that a construction project is a unique and temporary production system, and consequently needs a specific design in order to execute each project. Thus, non-existent or an unclear production system might be another reason for project failures. Thirdly, activity based methods, typically used in construction management, such as critical path and line of balance scheduling methods are also pinpointed as responsible for inefficient Production Management (Bashford et al., 2005). Fourthly, the construction industry usually employs a push type of production control for planning that has in itself been found to lead to unpredictability and loss of productivity. And fifthly, the lack of commitment within the project among the stakeholders, mainly at the lowest production level (direct laborers and sub-contractors), are also responsible for project delays and unreliable plans. Based on this background, the objective of this paper presents a brief literature review about each field presented above, and then discusses these themes. In all sections, findings from two case studies carried out in the UK are used to support the views presented.
2. CONSTRUCTION THEORIES AND IMPLEMENTATION

Theory-building is important because it provides a framework for analysis, facilitates efficiently development of the field, and is needed for the applicability to practical real world problems (Wacker, 1998). The procedure for a good theory-building research is justified as follow: it defines the variables, specifies the domain, builds internally consistent relationships, and makes specific predictions. Usually, theories are developed from observations and reflections taken in practice. Once they are built, theories should be returned to practice for their validation and applicability. Sometimes, comparisons based just on science are also used to support theory development.

A deficient or even inexistent theory of Production Management is justified by some authors by being the main cause for construction projects failures (Howell & Koskela, 2000, Koskela, 2000, Koskela & Howell, 2002). They argue that it is necessary a reform of Production Management driven by theories, improving then the management of workflows generated and delivered by each activity.

“It is the poverty of current theory that explains the other problems of project management, such as frequent project failures (Kharbanda & Pinto, 1996), lack of commitment towards project management methods (Forsberg & al., 1996) and slow rate of methodological renewal (Morris, 1994). Thus an explicit theory is the crucial and single most important issue for the future of the project management profession.”(Koskela & Howell, 2002)

According to present understanding of the theory of production, there are three views to production, each providing for a number of principles for the production system: transformation, flow and value generation - TFV (Koskela, 2000). Although it is incomplete, the theory of management consists of particular theories for planning, execution, and control. Apart from Production Management theory has been evolved significantly, construction practices do not apply theory in a systematic and comprehensive manner. Thus, poor implementation of theory is often found in construction cases. Santos et. al (2002) argue that a lack of motivation and inadequate conditions for enabling “learning” are the central causes for the great mismatch between current Production Management theory and construction practice.

The case studies identified that one company had good implementation but poor theory, with its production based just on the transformation (T) view. On the other hand, the other company had almost nothing regarding theory implementation; if it had some theory behind the processes it was implicit.

3. PRODUCTION SYSTEMS - DESIGN OF PROCESSES

It is argued that each construction project is unique; consequently, for each project there should be developed a specific production system. It is understood that production system is what will define the production process by which materials are transformed into construction works through the use of resource capacities under certain conditions. After the product development, the following step is the design of a production system, where the production flow is defined and all activities that do not add value to the process or, to the end product, should be minimized. In this phase, possible wastes in the process are also identified, with aim of: avoid, eliminate, or at least mitigate them.
Observing the gains of Toyota through applying ‘lean production’ techniques, some researchers in construction (Ballard, Howell, Koskela) founded the ‘International Group for Lean Construction’ in 1993, aiming to try obtaining similar gains to manufacturing industry by transporting this philosophy to construction. Thus, ‘lean’ is a way to design, control and improve production systems to minimize waste of materials, time, and effort in order to generate the maximum possible amount of value. Thus, production has three kinds of goal: getting intended products produced in general; cost minimization and optimising levels of utilization (internal goals); and needs of the customer, such as quality, dependability and flexibility (external goals) (Koskela et al., 2002).

Toyota has identified seven major types of non-value-adding waste in business or manufacturing processes, which are described below. They can be applied to product development, process, materials requirement, and in the office. One more kind of waste has been identified by Koskela (2004) increasing to eight types of waste that can be found in the construction industry:

- Overproduction;
- Waiting;
- Unnecessary transport or conveyance;
- Over-processing or incorrect processing;
- Excess inventory;
- Unnecessary movement;
- Defects/ reworks.
- Making-do (Tasks are started without all their standard inputs (materials, machinery, tools, personnel, external conditions, instructions, etc.))

Activities have to be executed in a logical sequence and without disruptions, whenever it is possible. Thus, a production system design takes into account all production requirements for the execution of the activities (sequence, external conditions, and resources). Production systems also provide standard forms for information flows and consequently data for decision-making at all hierarchical levels of the company. They should transmit the companies’ best practices and being constantly up to date. They also should transmit all experience and learning accumulated by the companies during their life, and they might have some variations from project to project (according with the typology of construction). A lack of a production system leads to waste. It occurs because there is no knowledge transferring based on the best practice of the company, continuous improvement, and learning process. Finally, production systems have to represent the whole project process, be transparent, and provide self-learning for who will read it.

The case studies revealed confirmed these issues. One company had its production system described in three booklets, supplying the managers with all information necessary for decision-making and execution of the production processes. What was noticed in this case is that the company was inflexible because its hierarchical structure and the managers were confined because the bureaucracy contented in the booklets. Thus, the company was not ready for a fast response to problems that emerged in the day-by-day on site. On the other hand, the second company does not rely on written documentation regarding its own production system. As result, what could be noticed in practice was more flexible and agile management but, a less transparent process that was cause of waste.
4. PRODUCTION MANAGEMENT METHODS

Nowadays there are two main methodologies for scheduling work in construction: activity-based scheduling and location-based scheduling. The first one leads with a network of activities dependencies and their respective durations. Among the main methods of activity-based scheduling are Gantt Charts, CPM, PERT, Critical Chain, etc. On the other hand, location-based scheduling assumes that successive activities use the same and consistent resources from unit to unit in multiple locations. As example among many methods we have Line-of-Balance, Vertical Production Method, Time-Location Matrix Model, etc (Kenley, 2004). Both methodologies have their strong points and their weakness which many times could be complemented by the other methodology. As example, to have a satisfactory Production Management, the method utilized must transmit a minimum amount of information to decision-makers as: WHAT, WHERE, and WHEN something have to be processed. These are the three premises to production management and here it is where the methods fail. They are not able to treat these three key pieces of information at the same time, in a clear optimal information display aiding decision-making. The activity-based scheduling does not involve the variable WHERE. The location-based scheduling usually does involve three of them, but it is poorly usable in complex and no repetitive projects.

A common problem in both methodologies is that they are not able to manage resources. Identify, measure, and allocate resources are fundamental for a reliable production control and consequently for a sound project. Kim and Garza (2005) proposed the Resource-Constrained Critical Path Method where they introduced resource-dependent activity relationship based on the original CPM schedule. It is not so different from other previous methods presented by other researchers, and its complexity makes manage more difficult. It is clear that better tools have to be developed for construction practitioners to manage workflow and production. The challenge is create a tool that is able to stepwise production control rates and buffer sizes by even labour crews, materials supply rates, equipment, and work hours, while random variations affect the outcome of each step.

There is also a framework deficiency for design production systems in construction. A lack of theory to support production system designs, prior to a job’s start, is responsible for future wastes in the process. Schedulers try to reduce complexity, but the management tools available for construction are not efficient.

Materials management is usually planned separately in construction and its integration with the other schedules is necessary. The buyer department is general isolated into the company and work under materials requirements coming from the site. These orders often do not arrive early enough to delivery the material in time.

Task-based methods turn production management complex because a unique task can involve several resources (materials, equipments, and crew). If these variables could be simplified, unified or isolated production management would become easier. For this, a defocus in the task concept is necessary.

What could be noticed in the case studies is that construction industry has been using bygone production methods or, using them in a wrong context. It generated great amounts of waste because the methods used to planning and control were not the most appropriated tool to lead with that determined production situation. Some difficult were observed in the use of the methods, such as: up to date, logical task sequence, and easy visualization and interpretation to anticipate possible problems in the production processes. This leads projects planning and control to failures as well.
Conventional production management is essentially about planning, i.e. manipulation of that representation (management-as-planning) (Johnston & Brennan, 1996). Here, management at the operations level is seen as consisting of creation, revision and implementation of plans. A criticism about this type of management is that the plans ‘push’ tasks to execution without taking the status of the production system into account. It leaves the tasks of management essentially uncoupled from everyday activity. The construction industry demands another approach, where human activity is core and production is responsive to the situation in question (management-as-organizing). Here ‘pull-systems’ take this situation into account, authorizing the release of work on the basis of system status.

However, in construction, it is normal to create a conceptual plan using a push-system type of scheduling in order to determine the logical sequence of works and identify the interdependence among the activities. In this phase, adoption of a ‘diverging/converging’ planning process (Laufer, 1997) is useful to analyze a company’s resources and supply data for the decision-makers to choose the best way for the project be carried-out. At this time, the project is in its conceptual and definition phase and the activities are of a ‘push’ nature, in order to create the logical sequence of process mentioned before. Here critical activities, bottlenecks, milestones, and project buffers are defined. Push-systems assume that all resources required to execute an activity that is about to start will indeed be available at that activity’s start time, i.e. each activity passively waits for its ingredients (instructions, labour, materials, equipment, and space) to become available (Tommelein, 1998).

At some stage within the project process it is necessary for the management method to migrate from a push-system to a pull-system. It is suggested that the optimal time for this transition is when the execution phase starts, because feedback then becomes more frequent. Push-systems control the release of jobs by controlling a Master Production Schedule. Projects which focus too much on the Master Plan, rather than on the milestones lead to ‘making-do’ type of waste. A pull technique is based on working from a target completion date backwards, which causes tasks to be defined and sequenced so that their completion releases work. Working backwards from a target completion date eliminates work but does not add value (Ballard, 2000). For implementation of pull-systems, improvements are needed in the areas of: work flow reliability in the site assembly process, and a reduction of the time required from order to delivery of materials at the site. The benefits of pulling are: shorter projects and reduced working capital tied up with inventories of materials; less labour time spent handling materials; and less loss, damage or misplacement of materials (Ballard, 1998). For a pull-system to be successful, it is important to achieve synergy among all organizations that do the work within the phase. Thus, teamwork techniques need to be implemented for planning and controlling the execution phase, e.g. the Last Planner System technique. Table 1 shows some relevant differences between push and pull-systems.

<table>
<thead>
<tr>
<th>Push Systems</th>
<th>Pull Systems</th>
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<tbody>
<tr>
<td>Schedule work releases</td>
<td>Authorize work releases</td>
</tr>
<tr>
<td>Based on market focus</td>
<td>Based on client focus</td>
</tr>
<tr>
<td>Stock piling</td>
<td>JIT deliveries</td>
</tr>
<tr>
<td>Inflexible</td>
<td>More flexible</td>
</tr>
<tr>
<td>Value is implicit</td>
<td>Pressure for higher value</td>
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</tbody>
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Table 1. Push vs. pull systems comparison
‘Management-as-planning’ is understood to be a recurrent formulation of management at the operations level in terms of the creation, revision and implementation of plans. It assumes that everyday activity itself is mediated by representations of the world and affected by the implementation of plans. On the other hand, there is ‘management-as-organizing’ where "attention is paid to structuring the physical, political and cultural setting of action, in recognition that purposeful action is an interaction between intelligent agents and structured environments, rather than just an information process. In short, management is seen as organizing things (we assumed here that the authors meant by ‘organizing things’, the resources’ organization, e.g. labour, materials, equipment, space, etc. It is a different view to ‘substance metaphysics’) rather than planning or scheduling them” (Johnston & Brennan, 1996).

Based on these descriptions we can assume that the ‘management-as-organizing’ approach is strongly linked with pull-systems. This way of management takes into consideration the organizational environment structure and not just a probabilistic scheduling of the activities as it is done in ‘management-as-planning’.

The two companies, where the case studies were carried out, have used push techniques for planning. Thus, works were released according to planned in the schedule. This assumption that all resources will be available before the work starts leads to waste, mainly in an uncertain environment like construction. These findings reinforce that changes in the practice philosophy are needed as well.

6. PROJECT COMMITMENT – HUMAN ASPECTS

A lack of commitment with the project is often observed in construction projects. A reason for this is that the majority of the workforce comes from subcontractors. As they are an independent company interest in profit, subcontractors tend to press project managers to release their jobs as soon and fast as possible. Doing this, they have in mind that can avoid idleness quickly moving their gangs for next contract (project) to increase profit. Operating the production system the manager might confront with variability. Sometimes is better select a reliable and capable subcontractor ready to handle with it, even if he/she has not the lowest bid (Koskela & Ballard, 2003).

In the Last Planner System technique there is a phase scheduling that involves integration and coordination of various specialists’ operations (subcontractors). The purpose of the phase scheduling is to produce a plan for completing a phase of work that maximizes value generation and one that everyone involved understands and supports; to produce a plan from which scheduled activities are drawn into the lookahead process to be exploded into operational detail and made ready for assignment in weekly work plans. The level of detail in the phase schedule is determined by the requirement that the phase schedule specify the handoffs between the specialists involved in doing the work in that phase. In this context, “specialist” is equivalent to “work group type” (Ballard & Howell, 2003). Participants in the phase scheduling process are representatives of those with work to do in the phase. For example, a team working to schedule a construction phase would typically involve the general contractor and subcontractors, and perhaps stakeholders such as designers, client, and regulatory agencies. Participants should bring relevant schedules and drawings including the master schedule and perhaps even the contract.

This team work that Last Planner assumes is very difficult to identify in construction sites. It occurs because nowadays companies are more interest in subcontracting work force, what generate less commitment with the project among stakeholders. Subcontractors usually are interested in their own profit trying to finish their job as soon...
as possible to relocate their gangs to another job (contract). Usually subcontractors press the managers to release their jobs. It leads, again, to making-do type of waste where activities are started without all resources available. On the other hand, contractors do not care too much with sub-contractors’ man hour losses by idleness, because it is not a direct cost for them.

Studies (Ballard, 1998) point that the use of pull techniques and team planning to develop schedules for each phase of work, from design to turnover, contributes to achieving continuous improvement. In the case studies, some managers did not believe in skills and knowledge transfer from one site to the next. A cause of this may be that the main workforce comes from subcontractors and it is assumed that the subcontractors should know how to do their jobs in the best way and improvements should therefore be their concern.

7. CONCLUSIONS

This paper presented just few relevant causes to failures happening in construction projects. The authors are aware that there are many other reasons that could be treated, such as: materials management, changes in the scope, uncertainty, complexity, etc. We have chosen these five topics because they are among the most significant reasons for failures in Production Management, as well as they are closely linked with the author’s research area. It is on the authors’ plans develop further research on theory based in production management, where contribution and implementation to the existent theory are the main focus. We are also not completely satisfied with the actual production management methods that the construction industry has been used. We expect that specific theory of construction would be useful to support generation of new methods and tool specific for production management in construction. Another important issue demonstrated in this paper is that construction fits to use a mix of push and pull techniques to management production. And finally, human aspects have to be taken in consideration, preferably bringing all stakeholders on board to be part of the scheduling phase, increasing then commitment to the project.

8. REFERENCES


