Reforming project management: the role of lean construction

Howell, GA and Koskela, LJ

REFORMING PROJECT MANAGEMENT: THE ROLE OF LEAN CONSTRUCTION

Gregory A. Howell, P.E. [1] and Lauri Koskela, Dr.Tech.[2]

ABSTRACT

Project management as taught by professional societies and applied in current practice must be reformed because it is inadequate today and its performance will continue to decline as projects become more uncertain, complex and pressed for speed. Project management is failing because of flawed assumptions and idealized theory: it rests on a faulty understanding of the nature or work in projects, and a deficient definition of control. It is argued that a reform of project management will be driven by theories from production management that add the management of workflow and the creation and delivery of value to the current emphasis on activities. Of all the approaches to production management, the theory and principles drawn from Lean Production seem to be best suited for project management. Promising results in this regard have been reached already in one project management area, namely in Lean Construction.

KEY WORDS

Project Management, Lean Production, Theory, Construction

[1] Director, Lean Construction Institute. Box 1003, Ketchum, Id, 208/726-9989, FAX 707/248-1369, ghowell@micron.net.

[2] Senior Research Scientist, VTT Building Technology, Concurrent Engineering, P.O.Box 1801, FIN-02044 VTT, Finland, Phone +358 9 4564556, Fax +358 9 4566251, E-mail lauri.koskela@vtt.fi

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INTRODUCTION

Project management as defined in the Body of Knowledge prepared by the Project Management Institute and applied in current practice must be reformed because it is inadequate today and its performance will continue to decline as projects become more uncertain, complex and pressed for speed. By "Project Management" we mean the forms of project management used in practice, taught in schools, and embodied in the Body of Knowledge of the Project Management Institute. This form of project management is failing because it rests on a faulty understanding of the nature or work in projects, and a deficient definition of control. Project controls based on this definition are unable to cause predictable outcomes and are themselves not in control. Worse, they hide the waste they create.

The combined effect of this faulty understanding and deficient approach to control leads to an over reliance on central authority and project schedules to manage resources and coordinate work. This form of management causes an unpredictable release of work between project activities. There is always a price to pay for variation in workflow. In projects this price is extended duration, lost performance and adversarial relations.

This paper attempts to analyze these root problems of the present doctrine and practice of project management and to pinpoint directions for reform.

WHAT IS PROJECT MANAGEMENT?

Project management is defined in the Project Management Body of Knowledge (PMBOK) of the Project Management Institute to as (Duncan 1996);

> "Project Management is the application of knowledge skills tools, and techniques to project activities in order to meet or exceed stakeholder needs and expectations from a project. Meeting or exceeding stakeholder needs and expectations invariably involves balancing competing demands among:
>
> - Scope, time, cost and quality
> - Stakeholders with differing needs and expectations
> - Identified requirements (needs) and unidentified requirements (expectations)."

Tools and techniques are offered for 1) developing an overall plan, 2) defining the scope of work to be completed, 3) breaking of the scope into activities or deliverable packages, 4) managing the time and cost for each activity, 5) managing quality and change. Great attention is paid to arranging the activities in a logical sequence usually in a critical path method (CPM) network, timing the start of each activity, monitoring progress of each activity and the larger network against the standards developed in estimating and scheduling, and taking corrective action on negative variances from the plan. The plan may be revised on occasion to reflect approved changes. Improvement or recovery occurs by speeding activities or reducing their cost, or by changing the sequential logic of the network.

Project management following the above definition is described in the PMBOK as the "subset of PMBOK that is *generally accepted.* Generally accepted means that the knowledge and practices described are applicable to most projects most of the time and there is widespread consensus about their value and usefulness". No underlying theory or basis is offered in support of these tools. Project management in practice, particularly in

construction in the United States centers on the preparation, approval and application of the CPM network.

There are certainly other formulations all sharing the primary characteristics of the formulation found in the PMBOK. Examples drawn from practice and presented in Journals rest on the same foundations with typical research efforts to improve resource allocation algorithms or management technology. For example, one model (Figure 1) is drawn from a recent article on the use of technology to enhance project management by the Port Authority of New York and New Jersey. (Zipf 2000). Here the project plan is prepared and then action shifts to monitoring, reporting and action based on variance.

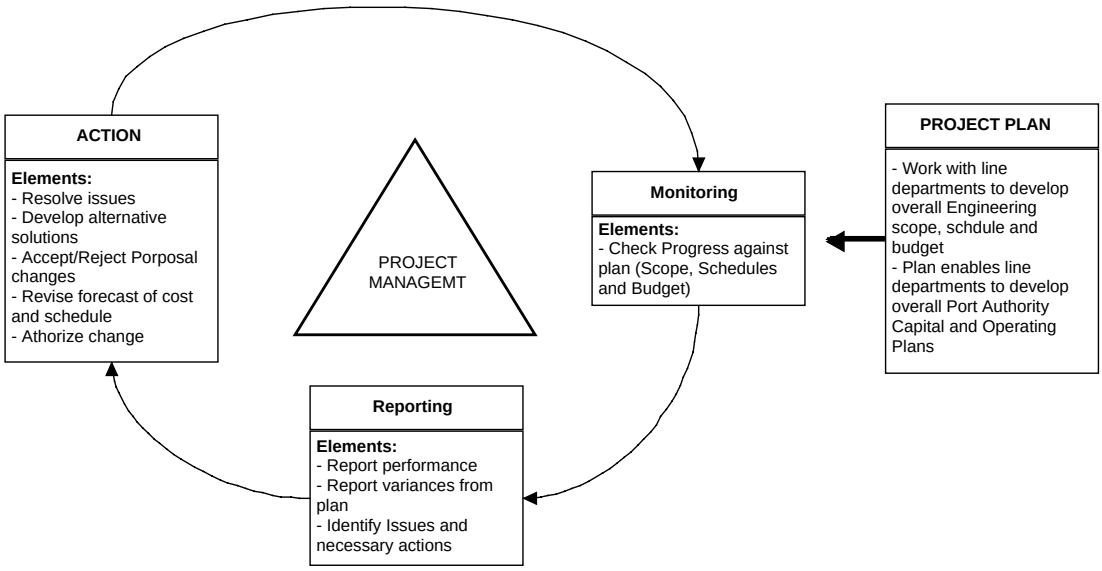

Figure 1: ***Project management applied by a public agency(Zipf 2000)***

In this model, project management is only concerned with the performance of activities within the plan and not with the management of those activities or their relationship. This is a system for managing contracts and must assume that all coordination and operational issues are managed within those boundaries. Value is apparently completely defined by scope, budget and schedule.

Another example of the current form of project management can be seen sketch of the planning system prepared by the planning director for a large building contractor. This company manages the construction of buildings and high technology manufacturing facilities under a wide range of design/build contractual formats. They are a powerful and respected company considered to be one of the best. Their planning system shows inputs to the rolling schedule from the master schedule (Figure 2). New activities are added to the rolling schedule each week and removed as completed. A print out of the rolling schedule is used by the superintendent in the form of a “clip board tracker” to monitor work in the field to assure activities are underway as planned. In this model what “should” be done is the only concern of the planning system while those people and activities concerned with what “can” be done operate below the “Steel Curtain”. Thus the rolling

schedule is out of contact with the planning and logistics systems that provide the wherewithal to do work.

Both the public agency system and the contractor system are manage the project as if it were an assembly of contracts that determined what each company should do and then monitors performance against that standard. In both cases, performance of the planning system itself is never measured or improved. All failures are considered to be the result of someone or company who failed to do what they "should" have done.

Interestingly, this is more or less the same flaw as observed in the Material Requirement Planning (MRP) systems in manufacturing (Hopp & Spearman 1996). The computed lead time in MRP does not consider the loading of the plant. Thus, it is assumed that the time required for a part to travel through the factory is the same whether the plant is empty or overflowing with work. Not unexpectedly, it has been observed that the MRP system actually can *increase* inventories, in contradiction to its original purpose.

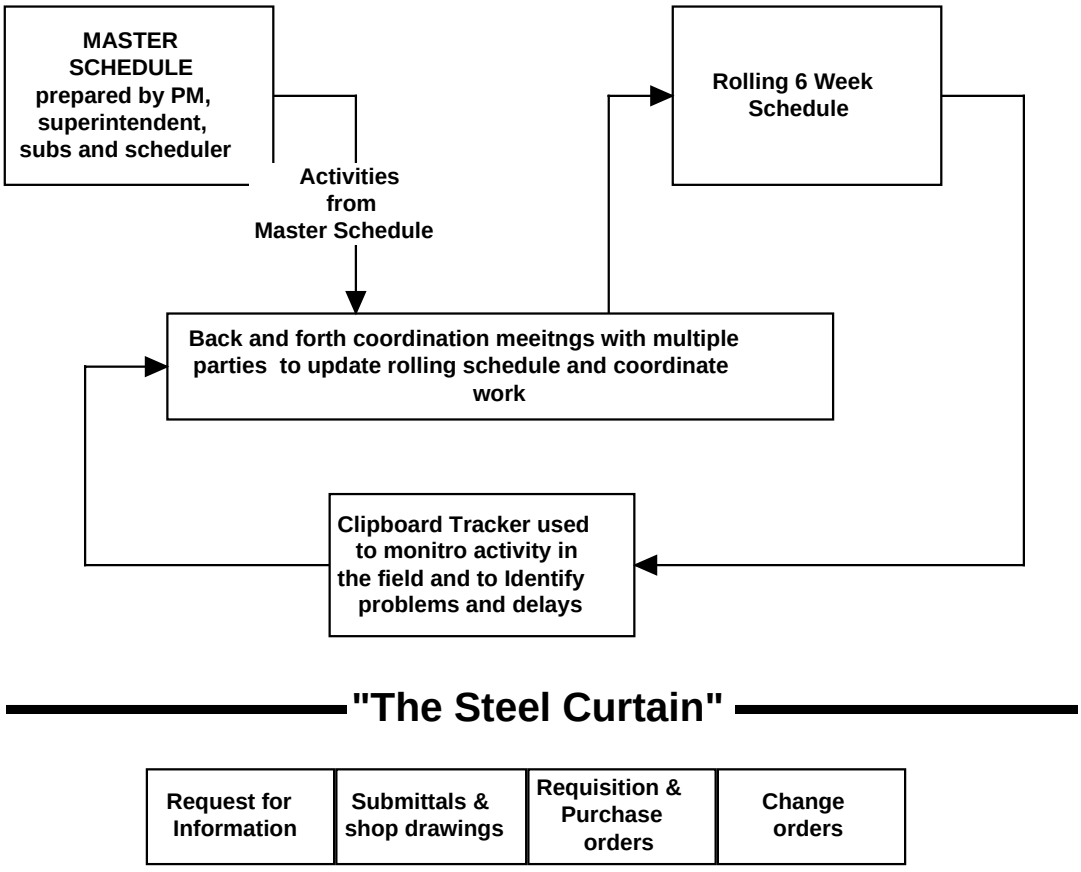

Figure 2: ***Project Planning and control system provided by design/build contractor working in the United States of America (Lean Construction 2000)***

However the system proposed by Zipf does make sense when project management is conceived in contractual management terms. In this view the activities are considered to be the responsibility of some person or company. This could work if those responsible do in fact have the ability to make them happen. In reality they do not. For example, the answer to a design question in the form of a request for information (RFI) may be

required before an activity can be made ready for work. But the designer is rarely under contract to the company asking the question, so the questions and answers become part of the contractual management posturing on the project.

ESSENTIAL FEATURES OF CURRENT PRACTICE

The PMBOK, academic and practitioner forms of project management share much in common. In each, a project has a well-defined scope and can be understood as a sequential dependent series of activities. The project is managed by central authority to assure activities meet schedule and budget targets. The relationship between activities is assumed to be simple and sequential. Control is the act of comparing variance from plan and taking action. Control actions attempt to return the project to its plan or manage the change. There is constant pressure to reduce time and or cost of activities even if there are no negative variances because the project manager is always trying to "meet or exceed" requirements. This effort almost always involves trading between time and cost.

Project managers then use various management and contractual techniques to balance the pain, or shift risk. Trade off between interests and the associated dissatisfactions are assumed going in with the project manager being advised, "In general differences between or among stakeholders should be resolved in favor of the customer." (Duncan p.17)

DEFICIENCIES IN CURRENT PROJECT MANAGEMENT

Current forms of project management are deficient in assumption and theory.

Assumption deficiencies include (Comments comparing assumption to reality are in parenthesis after each point.);

- Uncertainty as to scope and methods is low. (In fact it is often very high and subject to almost continuous change.)
- Relationships between activities are simple and sequential. (Reality is more complex. Activities are often interdependent meaning action in each affect the other. Resources shared between activities are the most obvious form of interdependence. Pressure for speed increases interaction as the number of activities underway at the same time increases.)
- Activity boundaries are rigid. (In reality downstream activities are rarely completely restrained from starting before upstream are finished. Upstream activities are often not complete when downstream activities begin. These fictions are useful for managing payment.)
- Control against standards for activities will assure outcomes, and outcomes can be improved by improving activities. (In reality this form of control causes people to do their work with little regard for how it might affect others. Work is selected to assure the cost or schedule report looks good even if this means doing work first that earns highest value but is of no use downstream. Pipefitters refer to this as "Show Pipe," that is the pipe that is installed quickly either because it lacks proper supports, is out of sequence, or simply has a high ratio of hours earned to expended. Thus it is done for "show" to benefit the contractor as opposed to achieving real progress in supporting project objectives

- Production management is not a project management concern[3].

Theoretical deficiencies are harder to identify because there is no clear statement of the underlying cause and effect model. However, from statements of leading project management authorities it is possible to deduce the underlying theory.

Morris describes the classic - and still current - project management approach as follows (Morris 1994):

> ...first, what needs to be done; second, who is going to do what; third, when actions are to be performed; fourth, how much is required to be spent in total, how much has been spent so far, and how much has still to be spent. ... Central to this sequence is the Work Breakdown Structure (WBS)...

According to Turner (1993), scope management is the *raison d'être* of project management. The purpose of scope management can be defined as follows: (1) an adequate or sufficient amount of work is done; (2) unnecessary work is not done; (3) the work that is done delivers the stated business purpose. According to Turner, the scope is defined through the work breakdown structure.

Thus, it is obvious that the project management discipline is applying the transformation model of production that has been used also in manufacturing in the major part of the 20th century (Koskela 2000). In the framework of this model, production is conceptualized as a transformation of inputs to outputs. There are a number of principles, by means of which production is managed. These principles suggest, for example, decomposing the total transformation hierarchically into smaller transformations, or tasks, and minimizing the cost of each task independently.

However, this foundation of production is an idealization, and in complex production settings the associated idealization error becomes unacceptably large. There are two main deficiencies: it is not recognized that there are also other phenomena in production besides transformations, and it is not recognized that it is not the transformation itself that makes the output valuable, but that the output conforms with the customer's requirements. The transformation view is instrumental in discovering which tasks are needed in a production undertaking and in getting them realized. However, the transformation view is not especially helpful in figuring out how not to use resources unnecessarily or how to ensure that customer requirements are met in the best manner. Therefore, production, managed in the conventional way, tends to become inefficient and ineffective.

SUMMARY OF THE NEED FOR REFORM

A new form of project management must rest on a more comprehensive theory or model for the way work is actually done, recognize and cope with uncertainty, bring project processes themselves under control, and redefine control itself.

COMPREHENSIVE THEORY

There are various ways to describe work and these shape our understanding. Glenn Ballard of the Lean Construction Institute has described a construction project as the simultaneous design of the product or facility and the delivery process. Others view

[3] PMBOK makes no reference to the management of production beyond stating that the project manager creates the environment where production can be managed. And of course it does but only as a series of activities.

projects as the reduction of uncertainty. Goldratt considers activity and flow perspectives. We are tended to add to this the creation and generation of value. The perspective that a comprehensive understanding would include activity, flow, and value is elaborated further in (Koskela 2000).

UNCERTAINTY

Significant uncertainty exists throughout a project. (Howell & Laufer 1993). Project management based on an illusion of certainty cannot be effective. Laufer has suggested practices for project managers related to identifying, reducing and coping with uncertainty (Laufer 1997).

CONTROL

Contracts can be managed by controlling against outcome variance from standards. This kind of control would propose that you can drive a car by referring to the speedometer, odometer and fuel gauges. Production management, which takes care of how work gets done, requires a more active sense of control. In this form, the steering wheel must be connected to the wheels and the gas pedal to the engine. In its defense, project management does not claim to manage production. Unfortunately, control actions applied in today's form of project management are not benign. As discussed above, efforts to make the reports for each activity look good can lead to selecting work in the ways that do not support project objectives. In effect, efforts to optimize activity performance reduce project performance.

WHY PRODUCTION MANAGEMENT ESSENTIAL TO REFORM

Perhaps when time was plentiful and projects were simpler, it was possible to manage them with techniques espoused by PMBOK. But the project of today and certainly those of the future will be pressed for speed. Reducing duration means more things will have to happen at once and have the potential to interact in ways not conceived in the simple sequential world. The pressure for speed increases complexity because interaction increases. And of course technical or design complexity is increasing as well. Project managers need tools that make it possible for them to manage production itself. Project management can no longer propose that production is the problem for some one else if it is to provide a basis for real control and predictable outcomes.

Production management is an old well-established discipline with roots in mathematics and engineering. Modern texts refer to the "Physics of Production" and the laws and rules needed for managing multiple dependent activities subject to uncertainty and variability (Hopp & Spearman 1996). Perhaps Project Managers believe that production management is only applicable for repetitive operations; they define a "Project" as a unique undertaking. But even making only one building still requires that the making of the whole and the pieces be managed.

WHY SHOULD PROJECT MANAGEMENT BE REFORMED WITH LEAN PRODUCTION?

It is not too unfair to propose that there are only two forms of production, Mass and Lean. Mass production shares significant assumptions with current forms of project management. Factories run on mass production principles focus on the speed and

efficiency of each activity using controls similar to project management. Mass production like Project Management is concerned more with the management of activities believing that will produce the best car or factory. Engineer Ohno changed the world forever by developing the ideals, principles, and practices of lean production. The ideal is to deliver instantly a product meeting the unique requirements of a customer and to have nothing in inventory. A car or building becomes the unique object described in the PMBOK. To deliver it instantly and from zero inventory is an impossible production management problem but the solution can be approached. The ideals of lean production mesh perfectly with the need to deliver instantly complex projects in an uncertain environment.

Control in lean production is a matter of causing specific actions to happen. Where mass production allowed defects to move downstream to keep the line running, current forms of project management make no attempt to assure assignments to crews meet criteria so they can be completed as planned. Lean thinking applied in construction measures the ability of the planning system at the assignment level to cause a specific outcome in a short period (Alarcon 1997, Ballard & Howell 1998). Reasons for failure to complete are identified and action taken to prevent recurrence. Lookahead Planning under lean is the progressive reduction of uncertainty to assure constraint free assignments are available.

The result is a growing awareness that reducing variation in workflow allows both time and cost to be reduced. Time is reduced because work is more precisely matched to labor and resources, and cost is reduced because predictable workflow allows just in time delivery of prerequisite work and supplies. So lean production manages both activities and the flow of resources between. But what of value?

In current practice, value is determined by the client at the outset and described in terms of scope, cost and schedule. In emerging lean construction practice, value is created in the iterative dialogue between ends and means (Ballard 2000). The need for stability is balanced against the reality that the world around a project and its technology are subject to change.

CONCLUSIONS

The practice and doctrine of project management suffers from flawed assumptions and idealized theory. In small, simple and slow projects, the consequent problems could be solved informally and without wider penalties. However, in the present big, complex and speedy projects, traditional project management is simply counterproductive; it creates self-inflicted problems that seriously undermine performance. A deficient theory is the root cause of the problems of project management: thus, we have first to solve the problems of theory before we can solve the problems of practice.

It can be argued that a reform of project management will be driven by theories from production management that add the management of workflow and the creation and delivery of value to the current emphasis on activities. Of all the approaches to production management, the theory and principles drawn from Lean Production seem to be best suited for project management. Promising results in this regard have been reached already in one project management area, namely in Lean Construction.

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