

MANAGEMENT THINKING BEHIND PERFORMANCE MEASURES

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ABSTRACT : The tools, methods and measures used for project control reflect underlying theories of management. Management theory has been neglected in the construction industry, which has rather focused on tools and neglected theory.

This paper contributes to the theory of project management by introducing and developing two fundamental and competing conceptualizations of management: MBM (Managing-by-Means) and MBR (Managing-by-results). Current project control and performance measurement practice is based on MBR. However, project control based on MBR may not be appropriate for managing dynamic projects. The paper presents the Last Planner™ System (LPS) and Process Variance Control (PVC) as examples of methods reflecting the MBM view. It is argued first that the MBM view is appropriate for managing uncertain, complex and quick projects. The paper also explores how MBR tools and techniques may be appropriately used within an MBM framework.

Key words : Last Planner™ System (LPS), managing-by-means, managing-by-results, performance measures, Process Variance Control (PVC), production control, project control

1. INTRODUCTION

A contractor deals with several formidable tasks during construction. Project control is one of the important challenges. Many different project control tools and measures are used in the industry and studied by academia to effectively implement a task of project control. With the advent of automation and information technology (IT), some tools are computerized so that immense amounts of information can be processed easily. Such improved technology encourages managers to try to control projects at more detailed levels than before. However, improved tools using the advanced technology have not improved project performance.

It has been argued that improvement in practice cannot be achieved without improved theory (Koskela and Vrijhoef 2000; Koskela and Howell 2002). A theory provides an explanation of observed behavior, and contributes to understanding as well as predicting future behavior (Koskela and Howell, 2002). A theory also provides the basis for the development of tools for analyzing, designing, and controlling. It is argued that construction has not had an explicit theory (Koskela 2000, Koskela and Howell 2002). In an effort to establish a theory of construction, Koskela (1997, 1999) proposed to understand construction as a type of production. Bertelsen (2003) has applied the theory of complex adaptive systems to construction. These have addressed the question: What is a project? There have also been some studies done on the question: What is project management? Notable in this regard is Koskela and Howell (2002). The contribution of this paper is to the theory of project management.

This paper endeavors to answer two questions. What management thinking (theory of management) underlies project control methods and tools? What management

thinking is more suitable to current construction project environments? The study uses the dichotomy between MBM (managing-by-means) and MBR (managing-by results) suggested by Johnson and Broms (2000) in answering these questions.

2. MANAGING-BY-RESULTS (MBR)

2.1 MBR Thinking

Johnson and Broms (2000) proposed a distinction in management theory between managing-by-results and managing-by-means. Traditionally, organizations are driven by financial targets believing that corporate goals can be achieved by each part of the organization (e.g., department or employee) reaching individual financial targets. Under this belief, a manager's role is to motivate employees to reach or exceed financial targets. Such management thinking was named by Johnson and Broms (2000) "manage-by-results" (MBR).

MBR thinking comes from quantitative thinking, which restricts one's perception to only one imposed dimension, whereas nature and organization consist of multiple dimensions (Johnson and Broms 2000). This quantitative thinking assumes that the observers and objects are separate from and independent of each other. Quantitative generalizations apply to mechanistic systems whose interactions can be defined entirely in quantitative terms. MBR thinking is appropriate to mechanical systems because it neglects the attributes of organizations that differ from mechanical systems. MBR thinking adopts the reductionistic assumption that optimizing parts of a whole optimizes the whole. That is not true for any system, even mechanical systems. If a motor can spin a shaft at 10000 rpm, but the shaft vibrates excessively at 3000 rpm, the system will not operate faster than 3000 rpm. Organizational systems have

even more complex relationships among their subsystems and parts, thus rendering the MBR reductionist assumption entirely inappropriate.

MBR thinking has some similarity with a theory of management-as-planning (Johnston 1995). Johnston and Brennan (1996)¹ argued that conventional production management at the operations level is based on an approach to management called management-as-planning. The management-as-planning approach views management as the creation, revision and implementation of the plan. Koskela and Howell (2002) have argued that traditional project management practice coincides with this view of management-as-planning. Both MBR thinking and the approach of management-as-planning assume that an observer (or agent) and objects (or world) are separate from and independent of each other. This assumption leads to hierarchical communication and centralized command and control (Koskela 2001; Johnston and Brennan 1996).

We now turn to specific project control practices that are based on MBR thinking; namely, the earned value method (EVM) and the resource based costing approach to controlling project overhead costs.

2.2 Earned Value Method (EVM)

EVM is a project control technique, which provides a quantitative measure of work performance (Fleming 1983). It involves crediting dollars or labor hours based on unit rates for the various types of work performed. The earned value technique is said to be superior to independent schedule and cost control for evaluating work progress in order to identify potential schedule slippage and areas of budget overruns. Work package and variance analysis are major components of EVM.

A Work Breakdown Structure (WBS) divides a project into the elements of work to be accomplished. Integrated with an **Organization Breakdown Structure (OBS)** that provides the “Responsibility” field, WBS defines cost accounts, which function as management control points. Management control points represent the most detailed breakdown for project control where resources are allocated, costs are collected and performance is formally assessed (McConnell 1984).

Each cost account is a control point. It is the lowest level at which individual variance analysis can be made. Variance analysis can be made at any point in a WBS hierarchy. C/SCS (Cost/Schedule Control System Criteria) issued by US DOD (Department of Defense) defines a cost account as “A management control point at which actual cost can be accumulated and compared to budgeted cost for work performed.

In EVM, the relevant variances are Cost Variance (CV) and Schedule Variance (SV). Data collected for analysis can be divided into three categories; Actual Cost of Work Performed (ACWP), Budgeted Cost of Work Performed

(BCWP), and Budgeted Cost of Work Scheduled (BCWS).

To investigate management thinking behind a project control method requires examining the assumptions of the method. Theoretically EVM assumes that a project can be broken into sub-projects (packages), which have contractual responsibilities and quantitative targets attached. Packages are independent of each other; i.e., they each represent a contractual obligation between one party (owner, general contractor, etc.) and multiple other parties (subcontractors), with no connection between one contract and another. It is assumed that a project will be successful if each work package resulting from WBS (Work Breakdown Structure) is managed and finished within its schedule/cost target. The goal of managers using this method is to improve financial performance (i.e., increasing earned value) of each account. From the perspective of management thinking, the method based on the assumptions above-mentioned reflects manage-by-results (MBR) thinking.

2.3 Accounting-Based Overhead Cost Control: Resource-Based Costing (RBC)

Traditionally overhead costs have been controlled mainly for tax and financial purposes, not for managerial purposes (Kim 2002; Coombs and Palmer 1989). Previous studies have shown that the construction industry tries to control overhead costs using resource-based costing, in which resources have individual cost accounts and are allocated to final cost objects directly (Kim and Ballard 2001, Kim 2002). Table 1 shows an example of resource-based costing. The goal of this accounting-based overhead cost control is to reduce the resource consumption of each account.

Table 1. Example of Cost Accounts in RBC

Cost Code	Description
700	Project administration
01	project manager
02	office manager
701	Construction supervision
01	superintendent
02	foreman
705	Project engineer
01	senior engineer
02	junior engineer
750	Permit and fees

The problem with resource based costing is that information on overhead costs does not show the processes that resources generate. Cost information on processes is important because where non-production costs are spent reveals what services and how much effort is expended on different ‘suppliers’; e.g., specialty contractors (Kim 2002).

Traditional accounting-based overhead cost control (i.e.,

¹ Management-as-planning (Johnston and Brennan 1996) is not the same as an approach of MBR thinking. However, the difference is not entailed in this paper because it is beyond the scope of the paper.

resource-based costing) assumes that resources are consumed by cost objects. The assumption is erroneous because resources are consumed not by products or services but by activities or processes. It prevents managers from looking at those processes or activities by which resources are consumed. For example, traditional costing shows the cost of project engineer, but does not show how much cost is consumed for what activities.

Current overhead control practice adopts MBR (manage-by-results) thinking in two ways. First, it adopts mechanical thinking in that the costing procedure neglects the processes generated by cost objects. Second, overhead cost control focuses on reducing the consumption of resources. However, the consumption of resources, which is represented as “costs,” is the result of many interdependent activities or processes of employees. Current practice fails to compile costs of processes, focusing management attention rather on results measures.

3. MANAGING-BY-MEANS (MBM)

3.1 MBM Thinking

As an antithesis of MBR, Johnson and Broms (2000) used the term MBM (Manage-By-Means). According to Johnson and Broms (2000), the difference between MBR and MBM practices reflects the differences between the principles that govern natural living systems and those that govern mechanistic systems.

The non-mechanical world such as business organization is not separated into independent parts. It is not important to maximize output and efficiency of each part, but to nurture relationships between parts. To manage projects or other forms of organization entails more than quantitative summing up of the separate contributions of each part (Johnson and Broms 2000; Johnson 1992).

The underlying belief of MBM is that what decides an organization’s long-term profitability is the way it organizes its work. It is only by looking away from desired results that they can be achieved. Trying to optimize each part of an organization separately results in one part cannibalizing another, and lowers the performance achieved by the entire system. Managers should be striving not to achieve financial targets but to adhere to disciplined practices such as attention on how work is done, nurturing relationships between parts of a system, and enabling those who do the work. An excellent example of this philosophy of management is provided by Jeffrey Liker’s account of Toyota’s management principles in his *The Toyota Way* (Liker, 2004).

MBM thinking has similarities with the approach of management-as-organizing even though the latter is limited to operations management (Johnston 1995; Johnston and Brennan 1996). Management-as-organizing assumes that an agent works as a fully functional part of the world with which it is in interaction as does MBM thinking (Johnston and Brennan 1996). Even though the manager sets goals, the manager works as architect of the organizational design, especially the means of communication between units (Johnston and Brennan 1996). This approach views human

activity as inherently situated, and holds that the structured nature of an environment contributes to purposeful acting (Johnston, 1995; Johnston and Brennan 1996). “Management-as-organizing” creates a planning system and facilitates performance by structuring the environment (Koskela, 2001).

3.2 Last Planner

Last Planner is a production planning and control tool to improve work flow reliability (Ballard 1994). Many companies have adopted the method and reported the results of case studies, and many reports and academic papers have provided evidence that Last Planner improved work flow reliability, thereby reducing project duration and cost (Kim and Jang 2005, Johansen and Porter 2003, Fiallo and Revelo 2002, Ballard 1999, Ballard et al. 1996).

Ballard and Howell (1994) proposed a shielding concept in planning called “last planner” to shield workers from uncertainty of work flow. The “Last Planner” is the last in the decision chain of the organization because the output of his/her planning process is not a directive for a lower level planning process, but results in production. As shown in Figure 1, Last Planner only releases workable jobs to the field, as opposed to the traditional practice of pushing assignments onto construction crews and design squads in order to meet scheduled dates. In addition to looking ahead and prescreening upcoming tasks for constraints, assignments are also expected to meet specific quality requirements for definition, sequence and size. In addition, since mistakes will still be made, the control system is structured to promote learning from plan failures, in an effort to avoid making the same mistakes twice.

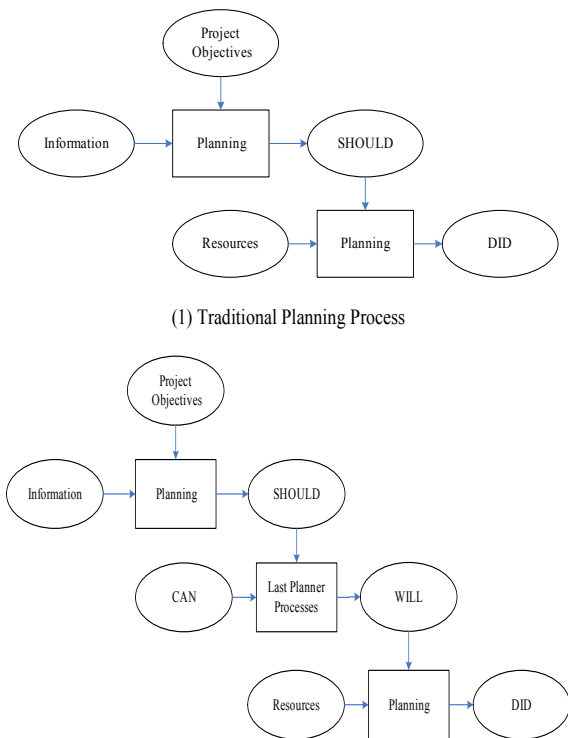


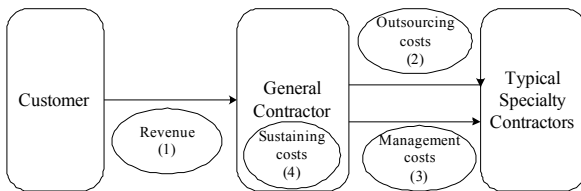
Figure 1. Planning Process (Ballard and Howell 1994)

Making quality assignments shields production units from work flow uncertainty, enabling those units to improve their own productivity, and also to improve the productivity of the downstream production units that receive and build on their work, and hence are dependent on the accuracy of the upstream work group's plans in order to do their own planning (Ballard and Howell 1997)

While traditional project control (e.g., earned value method) focuses on managing activity-by-activity with MBR thinking, the focus of the Last Planner is placed on work flow reliability; i.e., the predictable handoff of work between specialists. Monitoring is focused on planning reliability, not on financial metrics. This view of production control belongs to MBM thinking. Many case study results suggest that such a view is effective in managing dependency and variations of production characteristic of most current projects.

3.3 Profit Point Analysis: Process-Based Overhead Cost Control

A new overhead control method, profit point analysis (PPA), has been proposed within the lean construction community, which adopted activity-based costing from manufacturing (Kim and Ballard 2001, Kim 2002). Kim (2002) defined points where management costs arise as profit points (Figure 2). They are imaginary points where transactions between general contractor and specialty contractors occur: i.e., conduit of information flow. General contractors' profits depend on how they manage these points when contracts are made on a lump-sum basis.



* Legend: Profit = (1) – (2) – (3) – (4)

Figure 2. Cost Structure (General Contractor's Perspective)

Cost information is compiled from a company's management activities and collected at profit points. Then the result of activity analysis is applied to multiple cost objects such as specialty contractors. Cost information on multiple objects can give a company insight into its relationship with specialty contractors because management areas such as coordination are the hubs of a company's business activities on a project. In contrast, current accounting systems put all cost information into cost accounts which combine profit points.

Current accounting systems use resource-based costing in which each resource is an individual cost account (Kim and Ballard 2001). It assumes that resources are directly consumed by cost objects. The traditional system leads managers to try to reduce resource consumption, which makes it MBR thinking. Unlike resource-based costing, profit-point analysis assumes that resources are consumed by activities (or processes), and activities are consumed by

cost objects.

The goal of PPA is to provide cost information on processes and to specify contractors / suppliers so that managers can get insight into processes. A process view contributes to nurturing relationships with specialty contractors / suppliers because it helps to build reliability of each other. A process view enables users (both a general contractor and a specialty contractor) to identify management areas and activities that consume more resources than necessary for each specialty contractor or supplier. A general contractor and a specialty contractor can find ways to improve the problematic management areas and activities based on PPA results. As such, information flow between them can be improved.

4. REVISIT MBR VS. MBM: ACCOUNTING NUMBERS VS. RELATIONSHIP

As seen in examples of MBR-based control (i.e., earned value method, accounting-based overhead cost control), project control traditionally focuses on accounting numbers (i.e., budget and budgeted schedule), conceived with the purpose of minimizing negative variances from planned cost and schedule.

On the contrary, the goal of MBM-based control is to improve relationships among production units. In site operations, coordinating work flows improves relationships between production units. The coordination of work flow can be achieved by improving work flow reliability through the Last Planner.

In managing overhead costs, the goal of MBM based control is to nurture relationships between a general contractor and subcontractors. PPA (Profit Point Analysis) provides process cost information for each subcontractor, thereby pinpointing management areas that consume exceptionally high levels of resource when dealing with each specialty contractor. Management areas or activities that consume resources exceptionally, presumably lessen the information flow reliability.

Improving reliability leads to nurturing relationships with project participants. Building relationships comes from trusting each other. Trust comes from reliability, not from commitment or contract. In line with that, project control tools based on MBM thinking lead to nurturing relationships between project participants. Reducing cost and duration can be a by-product, not a destination.

Which management thinking is appropriate for managing current projects?

The paper showed the attributes of MBM and MBR thinking with examples of its application to construction management. The question what management thinking is appropriate for managing current projects requires investigating the characteristics of current construction projects.

Construction projects are now structurally complex and uncertain (Williams 1999). As projects are increasing in size and complexity, the number of participants involved in a project is increasing and pressed for time (Howell and Ballard 1996). A project may deal with an enormous number of hand-offs of work (materials and information), which brings about high levels of uncertainty and interdependency.

Reliability of work and information flow becomes more important than ever (Howell and Ballard 1996). Under such circumstances, research in the lean construction community has shown that work flow reliability must be achieved as a prerequisite to managing cost and schedule (Ballard and Howell 1994; Howell 1999). MBR tools to achieve financial targets may be used within an MBM framework once reliability is achieved.

5. TOOLS AND MANAGEMENT THINKING: LESSONS FROM CASE STUDIES

Results from previous case studies showed that MBM thinking and practice tends to achieve better end results than MBR. By creating the right conditions for performance, performance can be improved. So the goals of MBR are better achieved by those practicing MBM! However, it is critical that the primary goals be directed to means rather than to end results.

In implementing the Last Planner, some managers were found to use it as a micro MBR management tool by assigning and tracking costs on each weekly assignment. If cost information is incorporated into the weekly work plan before the culture of reliable promising is well established (Macomber and Howell 2003), it easily becomes the main decision criterion for releasing work assignments rather than the five quality criteria; thereby work flow can become unreliable. Unreliable work flow leads to longer durations and higher costs than estimated (Kim and Ballard 2000, Kim 2002, Kim and Jang 2005). Quality assignment criteria are likely to be sacrificed to earned-value.

In a case study on PPA, process cost information was sometimes used to claim additional time spent or to monitor employees' behavior and efficiency. If PPA information is intended to use to measure employee's efficiency or to monitor behavior, PPA leads to the "show pipe" in the office and destroys information flow reliability.

6. CONCLUSIONS

This paper contributes to a theory of project management by introducing and developing two fundamental and competing conceptualizations of management: MBM (Managing-by-Means) thinking and MBR (Managing-by-results) thinking. It showed that current project control practice comes from MBR thinking. However, project control based on MBR may not be appropriate for managing dynamic projects.

The paper presented the Last Planner™ System (LPS) and Profit Point Analysis (PPA) as examples of methods reflecting the MBM view. It suggested that the MBM view is appropriate for managing uncertain, complex and fragmented projects. The paper, however, gives practitioners warning that management thinking should accompany control tools. Otherwise, tools can be misused in pursuit of MBR goals, thereby assuring that those goals will not be achieved.

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