

Contrasting Project Production Control With Project Controls

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ABSTRACT

The primary purpose of this paper is to first define and then differentiate Project Controls and Project Production Control. The paper also provides a brief historical perspective and examples of the application of each discipline. The paper concludes that although the two disciplines are distinct, each plays a different and important role in Project Delivery.

Keywords: *Project Production Control; Project Controls; Project Delivery*

INTRODUCTION

Project Controls and Project Production Control, contrary to popular belief, are not synonymous. They are two separate disciplines and sets of practices with different origins, purposes and objectives. However, when implemented appropriately, they are complimentary in their approach to supporting effective project delivery.

Peter Drucker¹ described the differences between controls and control as follows:

“... The word ‘controls’ is not the plural of the word ‘control’ ... the two words have different meanings altogether. The synonyms for controls are ‘measurements’ and ‘information’. The synonym for control is direction ... Controls deal with facts, that is with events of the past. Control deals with expectations, that is, with the future.”

While the main function of Project Controls is to satisfy project accounting and reporting requirements, Project Production Control focuses on how work is planned, executed and improved. This paper describes how the conventional Project Controls function differently than Project Production Control and how project delivery organizations, from owners to service providers, will benefit from the proper use of both of these practices.

¹ Drucker, P. (1974). *Management: Tasks, Responsibilities, Practices*. Williams Heineneman Ltd.

PROJECT CONTROLS

The roots of Project Controls can be traced back to the early 20th century with the Scientific Management movement led by Frederick Taylor. Taylor proposed that management is a true science, resting upon clearly defined laws, rules and principles, and that one key to effective management was establishing systems that clearly define work processes.²

Henry Gantt, who was Taylor's colleague, introduced the use of bar charts that came to be known as the Gantt Chart, as seen below in Figure 1. These charts allow planners to graphically represent tasks and illustrate their relationships in time. During the same timeframe, a new role called Supervisor was created, with the sole responsibility being to plan the work to be performed by the craft workers. Through the combined use of bar charts and supervisors, a centralized scheduling approach that separated the planning function from the work execution function was formalized.

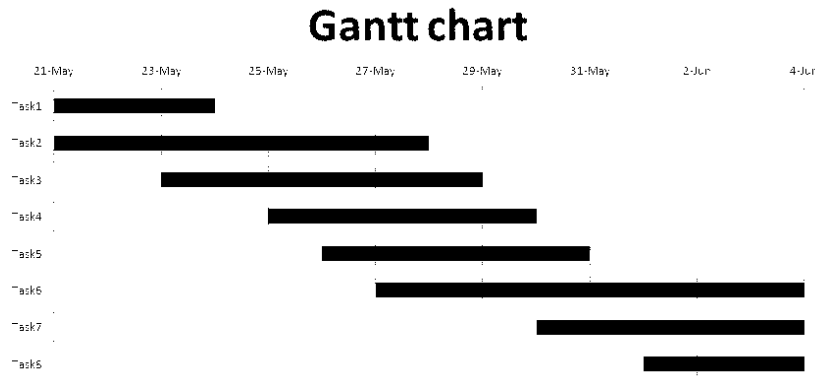


Fig. 1. Example Gantt Chart

Later in the century, during the 1950s, two new planning approaches were developed, the Critical Path Method (CPM), and the Program Evaluation and Review Technique (PERT). Both approaches used the logical relationships between project activities to develop a project schedule, but with slightly different objectives.

CPM was developed as a result of a joint effort between DuPont and Remington Rand's UNIVAC division, two commercial entities that were trying to more effectively predict and control project costs. CPM planning includes defining task activities, assigning durations to each, and then linking them in time, based on their dependencies. The critical path is the timeline through all the project tasks that yields the shortest theoretical project duration.

In CPM, there is often an assumed tradeoff between the cost of the project and its overall completion time, known as the time-cost trade-off. Activities are also assumed to have a fixed and predictable duration based on the amount of capacity (equipment, people and space) applied. So it may be possible to decrease the completion times of certain activities by adding more capacity, for example by spending

² Taylor, F.W. (1911). *Principles of Scientific Management*. New York, London, Harper & Brothers

more money or adding additional crews. One of management's challenges is to manage these time-cost trade-offs with respect to overall project objectives.

PERT, on the other hand, was developed to aid the U.S. Navy in the planning and control of its Polaris missile program at the time of the Cold War between the U.S. and Russia. The Polaris project goal was to design and deliver the first submarine-launched intercontinental ballistic missile. The U.S. believed that its land-based missiles and nuclear bombers were vulnerable to a first strike. Therefore, the U.S. Navy's objective was to complete the Polaris project as quickly as possible, with cost a secondary consideration.

However, since no such missile had ever been constructed, addressing uncertainty was a key requirement. For example, the most likely completion time for a particular activity might be four weeks, but it might range from three weeks to eight weeks. Therefore, PERT was developed to take into account the uncertainty inherent in activity durations and aimed to improve the validity and accuracy of schedule forecasts through stochastic analysis rather than the deterministic approach used by CPM.

Because computing power was expensive and scarce at the time, and required a highly skilled person to operate a computer, a single person would be responsible for creating and managing schedules using either PERT or CPM. This approach was consistent with Taylor's model of separating work planning and execution, and supported a centralized approach to work planning and scheduling. The emergence of high-speed low-cost computing and associated project management software in the 1980's established the role of the application specialist as project scheduler, and supported the emergence of project controls as a centralized function.

With increased pressure to estimate project cost-to-complete and to update financial statements based on project status, the main function of project controls has evolved into a centralized function focused on accounting, forecasting and reporting. These activities document progress against a preset budget or baseline schedule. In many cases this is performed through Earned Value Analysis (EVA), which attempts to "integrate scope, cost (or resource) and schedule to help the project managers assess project performance"³. As indicated by its name, EVA focuses on measuring the Earned Value of the work performed, as seen in Figure 2, and comparing it with Planned Value and Actual Cost to see how the project is performing against budget and schedule baselines created using conventional network scheduling approaches such as CPM or PERT.

3 Project Management Institute (2000). *A Guide to Project Management Body of Knowledge (2000 Edition)*

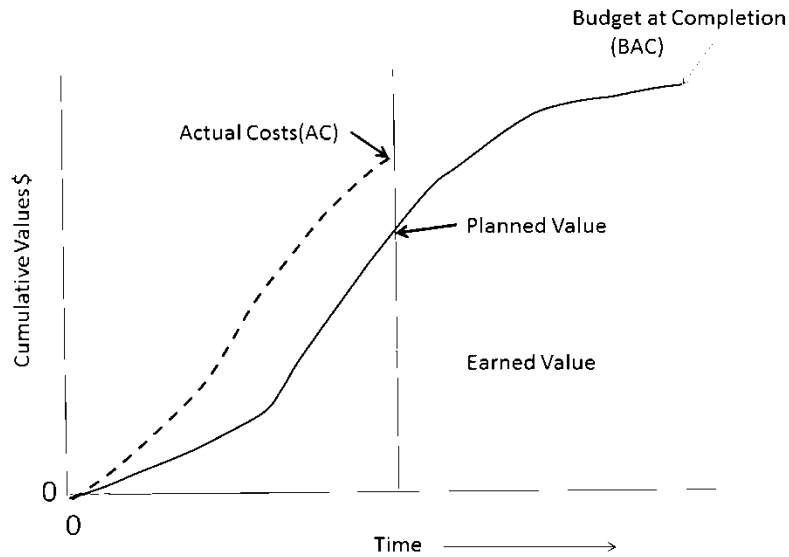


Fig. 2. Earned Value Analysis Chart (S Curve)

One key concept that is central to EVA is that of creating a baseline schedule and controlling or fixing scope in order to track and report variance. However, a project's critical path is typically dynamic due to numerous factors, including resource availability, changing customer requirements, site constraints and other sources of variability throughout the project execution process. Adhering to a fixed operational plan, rather than understanding the impact of change and updating the project plan on a regular basis, can impact the project team's ability to achieve overall project objectives and fails to provide a mechanism to respond to both natural and induced project variability, i.e. a means of control. In addition, under relational contracts such as Alliances, Frameworks, IPD, or IFOA (which are gaining momentum in the industry), the budgeted cost for a specific activity often fluctuates in order to optimize the whole project, making it difficult to assess progress against a fixed baseline.

George Heywood notes in a Project Management Institute paper that: "Project controls include such functions as estimating, planning and scheduling, cost control, risk analysis, and various reporting functions."⁴ The focus of project controls is to provide information to update financial statements and management reports through project status reporting and forecasting against a baseline plan. This has established the mission of project controls as an accounting and reporting function, rather than effectively planning and controlling production.

PROJECT PRODUCTION CONTROL

Production control can be broadly defined as any action, process, mechanism, system or combination that organizes and enables control of production, or work execution, beyond accidental or ad-hoc behavior. As a knowledge set and practice, Production Control is much older than project controls. However, even

⁴ Heywood, G.E. (1996). "Project controls: how much is enough?" Project Management Institute, *PM Network*, vol. 10, no. 11.

though projects have been classified as a type of production system for more than twenty years,⁵ the approach has generally been implemented in the manufacturing sector and less commonly on projects. Project Production Control applies the principles of industrial production control to the challenge of planning and executing project work.

As Drucker pointed out, “the synonym for control is direction ... control deals ... with the future.” Production control is primarily concerned with what will take place during the next production cycle.

Production control has always focused on exactly how work is planned, executed and improved. Its roots can be traced back to shipbuilding methods in the Middle Ages, and the concept has significantly evolved through its application to manufacturing processes beginning in the 1700s and factory work during the Industrial Revolution. Not only have control protocols such as push, pull, and CONWIP evolved, but the means of control has evolved as well, as seen in Table 1. Humans were originally the mechanism for performing production control. It was the shipbuilder’s experience that was used to control his work process, and his experience was handed down to apprentices. As the industrial world emerged, the use of physical types of control such as valves or governors became more prevalent. With the introduction of computer systems, production control evolved from human and physical types of control to software systems, such as Manufacturing Resource Planning (MRP) systems for manufacturing.

Control Mechanism	Example
Human	Experience, Judgment
Physical	Limit Switch, Diesel Engine Governor
Computer	Logic, Rules

Table 1. Examples of Production Control Mechanisms

The evolution of production control practices demonstrates the use of human, physical, and software systems as a means for implementing control in production systems. Current Project Production Control practices primarily utilize human experience in planning work – particularly the experience of those closest to the work. However, subject to the requirements of the production system, physical and software systems are generally preferred as control mechanisms due to their higher reliability and consistency. This approach intentionally leaves humans as the last resource for control. In other words, achieving higher reliability and consistency requires automated control of the human work.

In the case of project delivery, the execution of work mixes production of physical deliverables performed by craft workers (e.g., site installation activities) and non-physical deliverables (e.g., design development and engineering) by knowledge workers. These activities can take place sequentially or concurrently throughout the project life cycle with various degrees of iteration, particularly in engineering.

⁵ Schmenner, R.W. (1981). *Production Operations Management: Concepts and Situations*. Chicago: Science Research Associates.

Due to the inherent complexity of project production (multiple stakeholders, different locations, alternate sourcing options, etc.), the means through which production is planned, executed, controlled and improved must be tailored to the type of work and workers that perform it. In order to minimize discrepancies between how the work is planned and how it is executed, Project Production Control incorporates a distributed approach to planning work for execution whereby those responsible for executing the work plan their work. This is in contrast to a centralized approach where a scheduler creates a master schedule or plan, and then distributes the plan to project team members for execution, as Taylor advocated in the early part of the last century.

We call the distributed approach to scheduling *Production Scheduling*. The production schedule determines what resources – capacity, inventory or time – will be required to perform the work to achieve the agreed upon project milestones. However, even when a production schedule has been developed by those directly responsible for the work, the schedule still has to be constantly updated, executed, and therefore, controlled. Control of work during execution, through the application of Project Production Control mechanisms, provides a means to incorporate or minimize variability (whether intentional or unintentional) in order to bring greater predictability and reliability to future work.

Production Planning is the mechanism through which the Production Schedule is executed and controlled. The Production Planning process focuses on optimizing the use of applied resources (capacity and inventory) for a specific time frame or control cycle, whether it be a shift, a day or a week through the creation and updating of production plans for that cycle. This requires that project teams meet regularly, according to the agreed control cycle, to make commitments about exactly what work will be executed in the next cycle. By creating the production plan for the next work cycle, control is systematically introduced to the planning process.

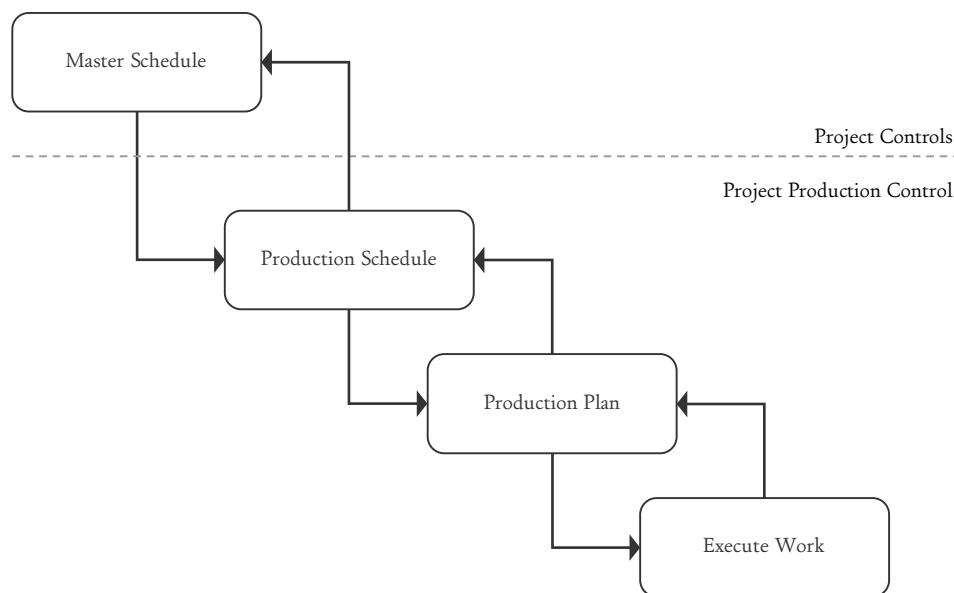


Fig. 3. Project Controls and Project Production Control Schematic

In contrast to project controls, Project Production Control is a practice that requires regular and timely attention to the details of executing work - every day, every week, every work cycle - before work is done as opposed to after work is done.

It is not a process performed once a month or on an ad-hoc basis. Production control is a key element for successful project delivery from project kickoff to the end of the project life cycle, because it addresses the application of resources and the adjustment of plans according to variability in work execution. This forms the basis of reportable cost, time, and quality metrics.

INTEGRATED PROJECT CONTROLS AND PROJECT PRODUCTION CONTROL

Project controls and Project Production Control represent two different knowledge sets and practice areas (as seen in Table 2). However, the two approaches complement and support each other. Both should be considered key elements of project delivery strategies. Project controls is driven by accounting requirements to estimate and track costs, to update financial statements, and *to report on project status* to support the associated business case.

Table 2. Key Attributes of Project Controls and Project Production Control

Project Controls	Project Production Control
Centralized Planning	Distributed Planning
Task Descriptions	Specific Actionable Tasks
Focus on Reporting	Focus on Work Execution Optimization

Project Production Control drives how work gets executed to *deliver* that business case. Production control provides the means through which real progress is measured, controlled and delivered. Project production outputs are the inputs for project controls reporting.

The combined implementation of processes and enabling systems associated with project controls and Project Production Control sometimes confuses project stakeholders because each requires a type of scheduling activity to accomplish its purpose. However, although both processes address temporal sequencing and relationships, they are applied at different levels of detail and the associated policies and performance metrics are different. Project controls creates and manages master schedules and helps to establish project objectives and milestones. These objectives and milestones drive the project production scheduling and planning processes that determine exactly how work will be executed and how resources will be applied and coordinated.

Therefore, an important requirement for a combined implementation is a clear definition of schedule management procedures. One way to establish a framework for schedule management is to constrain the development of detailed master schedules to a master milestone level. Then, by emphasizing short-range planning by those responsible for the work, production schedules can focus on exactly the how work must be executed to ensure those milestones can best be met.

The combination of the reporting function of project controls and the greater insight and control of work offered by Project Production Control allows a more robust and integrated perspective on project performance.

SUMMARY AND CONCLUSIONS

Project Controls and Project Production Control are distinct, separate processes and disciplines. Each can add value to the overall execution strategy of a project. However, the differences should be well understood prior to establishing the overall project scheduling and control strategy to ensure that resources are efficiently utilized.