Dynamic Scheduling Methodology (DSM)
with
Primavera™ P6

A whitepaper
by
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Introduction

Computer Technology and the Project Management Office (PMO)

In the past two decades advancements in computer technology have enhanced the capability of a Project Scheduler to produce a very detailed Project Plan\(^1\), with the added bonus of nice-looking Gantt Charts, KPI Dashboards, and impressive reports and graphs. Advancements in computer technology also made possible, for scheduling software such as Primavera™ P6, to self-perform the scheduling function through a series of dynamic programming algorithms capable of scheduling up to eighty percent of a project’s activities, with the speed and accuracy needed to keep pace with the ever-changing environment of construction or maintenance projects—more so than any Project Scheduler could ever dream of doing manually. So why is it that most Project Schedulers insist on creating Project Plans using manual, static scheduling techniques? Why is it that many PMO/Project Controls Teams struggle to control work and manage costs and resources?

This paper explores how dynamic scheduling has the significant potential to become the defining methodology in project management and controls, as well as the optimal way to balance the benefits of dynamic scheduling against static scheduling in an effort to control direct \textit{and} indirect project activities in real-time using the latest technology.

For the past sixteen years I have been experimenting with creating scheduling methodologies designed to control each phase of complex and risky projects—such as STO (Shutdowsns, Turnarounds and Outages), Commissioning and Startup, and EPC (Engineering, Procurement and Construction)—across a variety of industries, cultures and geographical regions on projects ranging from $100M USD to $5B USD. My goal was to maximize the usefulness of technology to do what the human brain was not capable of doing—calculating multiple fields of data to produce an optimized Project Plan (lowest cost, shortest duration, least amount of resources) with the ability to perform ‘what-if’ scenarios and generate revised Project Plans—\textit{in real-time}.

Why Dynamic Scheduling Methodology (DSM)?

Outside of Activity logic\(^2\), no project ever goes according to plan. That is to say, \textit{which} Activities have been planned (objectively with logic, and subjectively with estimates) may be more-or-less true. \textit{When} the Activities have been scheduled, however, is more often than not false, given that no crystal ball has yet been invented to allow Project Schedulers a glimpse into the future—the very reason why Project Schedulers should look-away from the so called \textit{Look-ahead Schedules} that torment Project and Construction Managers, and diminish the Project

\footnotesize
\begin{itemize}
  \item \textsuperscript{1} Project Plans are often referred to as Schedules; however, schedule is a verb, an action required to produce a Project Plan (noun, product) — Ej Lister
  \item \textsuperscript{2} Activity logic succeeds the planning of Activities in a Work Order or Construction Work Package and precedes the estimation process. Activity logic is not the same as Task Relationships; the latter being created during manual scheduling by the Project Scheduler.
\end{itemize}
Scheduler’s value—as conditions change and their ability to react to changing conditions and mitigate risk are limited—in the absence of DSM. Only on a Level I Plan (see Illustration 1.2: Dynamic Scheduling with Primavera™ P6, p.8) should Activities remain fixed—these are the contractually agree upon Milestone Scorecards, Level-of-Effort Activities and dependent [CPM] Tasks that demand the practice of DSM—because without DSM the chances of meeting these Milestone Scorecards is substantially reduced.

The current paradigms which exist within most PMO’s is that planning and scheduling are functions practiced by people with experience in Project Management Software; P6 Jockeys, as it were—whose experience in Project Management and/or Construction Management in the real-world is often limited. To make matters worse, the Project Scheduler’s role does not include the responsibilities associated with project controls; often they are not integrated into the Project Controls Team as a vital contributor to Risk Mitigation and Change Management. To compound this problem even further is the fact that most Project Schedulers have been self-taught (or coached by incompetent cohorts); creating what many refer to as Schedules, using static scheduling techniques—such as: Relationships, Constraints, and Milestone Hammocks—where no formal methodology exists, let alone, DSM. This ultimately produces a rigid Project Plan; often not optimized, and never flexible or dynamic.

There exists a significant lack of methodology, policies, procedures and guidelines from industry practices when it comes to scheduling in the project environment these days, even though the technology is now available to support it, (Which came first, the methodology or the technology?).

**Key benefits of DSM**

1. DSM establishes a process (roadmap), allowing the PMO to navigate—focusing on efficiency and change management—during the Planning, Scheduling and Project Control Phases, with each phase of the DSM supported by Key Deliverables, Milestone Scorecards, Policies, Procedures, Templates, and Checklist Tools.

2. Data Integrity and Document Control (DIDC). No PMO will ever be successful controlling their Project Plan in the absence of DIDC. Using DSM, with its technology partner, e.g., Primavera™ P6, will ensure all data and documents are controlled in a dynamic environment by a custodian whose relationship with the PMO team members is one-to-many.

3. The ability to perform ‘what-if’ analysis and risk mitigation scenarios in real-time using DSM as opposed to SSM (Static Scheduling Methodology) to produce an optimized Project Plan (*Lowest Cost, Shortest Duration, Least amount of Resources*).

4. Each time the Project Plan slips during ‘Updating and Progressing’, the Project Scheduler must manually determine the ‘Driving Activities’ and find solutions to minimize Variance using SSM, often taking a great deal of time to execute static simulations to mitigate risk and recover their Project Plan. With DSM much of the problem-solving can be done by the computer using the Project Schedulers input, which takes a fraction of the
time—in fact, it can often be done during a workshop exercise with the PMO members present, in real-time.

5. Creating the Project Plan using DSM, in conjunction with the PMO Stakeholders ensures they work from a Strategic Plan (effective), which includes Risk Mitigation and Change Management Methodologies to create a Project Plan based on Safety, Quality and Efficiency.

6. Project Plans can be re-scheduled within minutes of changes and variances being reported, as opposed to hours or days using SSM during the Project Execution (Construction) Phase.

7. On complex, risky and high-activity projects like maintenance shutdowns, or during project phases like commissioning and startup DSM is invaluable. These projects are scheduled down to a Level V [Resourced] Plan using Work Orders (WO), Factory Acceptance Testing (FAT) and/or Turn-over Packages (TOP) in conjunction with a true-geographical/physical process WBS and updated and re-scheduled daily. You cannot do this type of work using SSM.

Note: DSM does not encourage changes in the Project Plan, nor does it encourage updates to the Project Baseline; rather, DSM is used as a proactive risk-mitigation tool prior to establishing the PPBL and used as a reactive change management tool after establishing the PPBL. DSM does not change the rules that pertain to CPM (Critical Path Method) on a Level I – Level III Plan.

Premise

The DSM I have developed, in conjunction with Primavera™ P6, is based on the premise that scheduling is a verb—an action performed by the Project Scheduler using manual scheduling techniques such as relationships and constraints then refreshing the data using the F9 function key; or, an action performed by Primavera™ P6 using its Resource Levelling function to produce an optimized Project Plan (noun). The latter, however, is a misnomer; no project should ever be scheduled by simply levelling resources since Earned-value Performance Management (EvPM) is dependent on efficient utilization of resources based on strategic planning for effective scheduling of work and commodities. More importantly, the basis for controlling a Project Plan is to ensure its Activity logic is retained, while Activity start and finish times remain flexible enough to adjust to changing conditions where float exists. My point here is that there are two Project Schedulers in the room, responsible for creating the Project Plan: the human (static scheduling), and the computer (dynamic scheduling). Understanding who does what, when, is a vital principle to the premise of explaining and implementing DSM.
The 3 Principles of a High-performance PMO: Methodology, Technology and People

Methodology

A Project Management Office, abbreviated to PMO, is a group or department within a business, agency or enterprise that defines and maintains standards for project management within the organization. The PMO strives to standardize and introduce economies of repetition in the execution of projects.

The PMO is the source of documentation, guidance and metrics on the practice of project management and execution. In some organizations this is known as the Program Management Office\(^3\) (sometimes abbreviated to PgMO to differentiate); the subtle difference is that program management relates to governing the management of several related projects. DSM fits into the PgMO.

DSM forms the backbone of project scheduling, designed to support the PMO with formal language, terminology, policies, procedures, guidelines, and templates—including training and coaching programs—through which a timeline of milestones, events and steps are practiced. Technology is then configured to support the DSM, followed by training and coaching of people in both methodology and technology to enhance the level of competence required to add value to the PMO.

It is surprising to me the number of companies that rely on technology and people to manage projects using no formal methodology; making it difficult to mitigate risk, manage change, run ‘what-if’ scenarios for analysis, or to meet project targets. No Project Scheduler can successfully do these using traditional, manual and static scheduling methodologies. Is it any wonder inefficiencies and lack of control stretch project limits? No amount of technology or competent people can make up for a lack of methodology.

Once the DSM is developed it must be seamlessly implemented into its technology partners\(^4\) (ERP, CMMS, PS, DC, etc.) and consistently practiced by its people partners\(^5\) (PMO, PM, CM, PS, etc.) where data integrity, document control and dynamic measurement systems combine to create a high-performance culture within the PMO.

DSM provides the PMO with a roadmap designed to establish the best possible, optimized Project Plan using ‘what-if’ scenarios and risk-mitigation techniques, while providing the Project Scheduler with the ability to generate change management options for the PMO to choose from when variances from the PPBL are reported. Again, the key benefit is reaction-time. A Project Scheduler can react to changing conditions and variance within hours; more often than not, within minutes of the PMO requesting solutions. This cannot be done through traditional SSM.

\(^3\) [http://www.slideshare.net/KYLUCAS/the-effective-program-management-office-pgmo-c-2010](http://www.slideshare.net/KYLUCAS/the-effective-program-management-office-pgmo-c-2010)

\(^4\) SAP®, JDE®, Maximo®, Microsoft® Project, Primavera™, Oracle, Aconex®

\(^5\) Project Management Team, Project Scheduler, Project Manager, Construction Manager
DSM is dependent on the following indirect actions executed by the various PMO Disciplines and Stakeholders:

**Actions/Responsibility**

- Scope of Work/Budget - PMO
- Strategic Planning - PMO
- Work Breakdown Structure (WBS) – Project Scheduler
  - *Based on a geographical, physical breakdown of the finished project, e.g., a gas plant with utilities and processes where the WBS is created as a hierarchy of units, systems, sub-systems, and equipment/lines (the lowest level of the WBS hierarchy). There is no time (timeline) associated with the WBS, i.e., do not use WBS to phase your project, e.g., Pre, Post, Commission, etc.*
- Organizational Breakdown Structure (OBS) - PMO
- Phase Calendars – PMO/Project Scheduler
  - *Based on a timeline of Disciplines and/or Stakeholders, and if applicable, to WBS elements, e.g., Earthworks, Civil, Structural, Steam System, Commissioning, etc.*
- Detailed Planning - Engineering/Planning
  - *Tasks, Activities & Logic*
- Estimating – Engineering/Planning
  - *Time/Duration, Resources, Indirects, Materials, Cranes, etc.*
- Scheduling (Level I – Level III) – Project Scheduler
- Programming – PMO/Project Scheduler
  - *Resource Limits*
  - *Calendars*
  - *Task Priority*
  - *Activity Levelling Priority*
  - *Project and Levelling Defaults/Settings/Calculations*
- Scheduling (Level IV & Level V) – Primavera™ P6

**Technology**

Both MS Project® and Primavera™ P6, to name the two most widely used project scheduling applications can be customized (configured) to support DSM. Myself, I prefer to use Primavera™ P6 due to its Oracle® database, powerful algorithms, customizable data fields and views, and its import/export and report writing capabilities. But do not be fooled, neither one of these applications was designed specifically for DSM. Much of their design and programming is focused on a SSM. Perhaps this is the reason why so many Project Schedulers never push these applications to their limits by configuring them to meet the expectations of a DSM environment; either that, or they do not understand DSM to begin with (see People).

Despite having a powerful project scheduling tool like Primavera™ P6, most PMO team members believe it is a Project Scheduler’s tool, meant solely for creating a nice-looking Project Plan (Gantt Chart) while they [PMO team members] use a multitude of applications like, Windows Explorer®, MS Excel®, MS Access®, SAP®, Oracle®-JDE®, Access®, and Document Control Apps (DCas), etc. to manage data—data which may or may not be compatible, accurate
or accessible to everyone; one of the key benefits of DSM is DIDC. Primavera™ P6 can manage and control cost, schedule, resources, timesheets, indirects, directs, work procedures & document links, risks, issues, notes, comments, roles & responsibilities, EvPM, and much more, making it ideal for the PMO and its team members (people) who simply need only be educated, certified and qualified in its functionality to ensure DIDC is established using the most appropriate platform integration.

People

There are two types of people involved in a project; those who are directly involved in the execution of the project activities, i.e., constructing or creating to deliver a product or service, e.g., Trades, Engineers, Laborers, etc., and those who are indirectly involved, e.g., Managers, Supervisors, Administrators, etc., all of whom have a defined role, with related responsibilities. However, unlike methodology and/or technology, both of which belong to the Organization (people come and go, bringing with them, and taking with them their experiences, attitude, competence and skills—which may or may not align with the existing PMO culture or its methodology and/or technology). It is therefore easy to see how the absence of a formal methodology for project scheduling may result in a Project Scheduler—whose level of experience and competence in technology (Primavera™ P6, for example) may not be sufficient—creating a less than satisfactory Project Plan.

People must be certified (trained) and qualified (coached) on a formal methodology and its supporting technology by experience personnel, i.e., Instructors, Coaches, Supervisors or Managers using a defined competency matrix for each individual, for each role, e.g., Project Scheduler, Project Planner, Planning Engineering.

To ensure a high-performing PMO people must be competent, and the PMO culture must be firmly valued in principles of a formal methodology and its supporting technology. DSM is just one of the best-practices associated with a high-performing PMO.

Risk Mitigation and Change Management

Risk Mitigation

An effective PMO will use Risk Mitigation to minimize the probability and consequence associated with executing a Project Plan. Using DSM to generate ‘what-if’ scenarios prior to approving the Baseline Project Plan (BLPP) allows the PMO to set realistic KPI targets with achievable objects for obtaining them. By using Productivity Factors (Pf) based on Probability and Consequence the PMO can generate Lagging Indicators using a fifteen-day moving average to forecast (Leading Indicators) the burn-rate (cash flow) and the Earned-value Performance.  

Note: Earned-value Performance is equal to the % complete of an Activity, whereas Actual-value Performance is equal to the $ spent; both measured against Planned/Budgeted to report on the Cost Performance Index (CPI) and Schedule Performance Index (SPI), which takes into
account Variance at the Level I, II, and III Plans related to slippage, where no client/contractual float is available.

Using the Risk Module in Primavera™ P6 in conjunction with the Issues Table can significantly help the PMO mitigate and manage risk; simultaneously managing changing conditions.

**Change Management**

An efficient PMO will use Change Management to enhance daily Earned-value Performance, avoiding costly float and below average Actual-value Performance (high-cost for low effort). Change Management refers to (1) a Scope of Work (SOW) reduction or increase, or (2) a variance in Level I – III Plans where Milestone Scorecards, Level-of-Effort ($) and/or Task Dependent Activities with no float—or Client/Owner float—are compromised; or forecasted to be compromised with Leading Indicators as indicated on the EvPM curves (see Illustration 1.2: EvPM Curves, p.8).

In reference to (1) and (2) it will be necessary for the PMO to submit a Change Request to the Client/Owner indicating the impact on CPI and SPI and the risk mitigation plan intended to make the change. If the change affects only Level IV – V Plans where the PMO owns the float, no formal Change Request is required.

**Project Plan**

Most, if not all PMO’s—and their respective clients—refer to the Project Plan as a Schedule; which, in its simplest form—a nice-looking Gantt chart—it is. But do not let this fool you. As I’ve previously mentioned, schedule is a verb used to convert strategic plans into to the overall Project Plan. The Project Plan itself is a culmination of each stakeholder’s (Client/Investor, Engineering, Materials Management, Cost Control, QA/QC, Document Control, Logistics, PMO, GIS, Permitting, Safety/Environment, etc.) strategic plans, objectives, milestones, etc., integrated into a system like Primavera™ P6 to produce a Project Plan for the management, measurement and control of all activities—direct and indirect—required to deliver on the PMO’s primary goal: *Project Completion in adherence to the Project Key Performance Indices (KPI's) and Key Deliverable Targets (KDT’s).*

**Data Integrity and Document Control (DIDC)**

“If the PM is the captain of your PMO ship, DIDC is its rudder. Lose the rudder, lose the ship…”

—Ej (Ted) Lister

The Project Plan provides the roadmap for the PMO to follow to reach their intended destination; therefore, it is absolutely critical that information flows into the Project Plan with integrity, and flows along its designed route in such a way that we can know in real-time where we are, and where we need to be. All data and documents related to the Project Plan must be controlled when adding, editing, revising, deleting, and/or analyzing, through a defined DIDC
process with standards, templates, tools, procedures and policies. This is how a high-performance PMO operates.

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Illustrations

Illustration 1.1: Dynamic Scheduling with Primavera™ P6

Illustration 1.2: EvPM Curves