Planning and Reporting Integrity - Key to an Effective Management System

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Introduction

A project plan with integrity is the centerpiece of an effective project management system. This paper describes what such a plan should contain, the data that should be collected to monitor its progress, and the data that should be reported to Project Managers (PM's) and executives to help them control it.

How the Project is Viewed by the Project Plan

The project plan sees a project as initiated by one or more external prerequisite events and performing a series of tasks which produce one or more deliverables to the outside world. A computer based project management tool is indispensable for representing the large number of interdependent conditions that can occur on a complex project. The tool provides the ability to optimize the plan to fit one's requirements by answering questions such as: What happens to the task schedule, deliverable dates, and costs if I change the number of participants? if I increase overtime? if I eliminate a deliverable? if I reduce quality? if one of the external prerequisites is late? The project plan is used to simulate, or model, what will happen from the time the first prerequisite event occurs to the time the last deliverable takes place. It shows the dates that each task should start and end, who will do each task, and how much work each person will do on each task. The plan also shows project cost for each time period and the total project cost.

Once all agree on the plan project participants use it to guide their activities. During implementation of the plan, by asking participants what they have accomplished each week one can generate a wide variety of reports to assess whether the plan is on schedule, identify the work that should have been done but was not, determine what must be done to maintain the deliverable schedule, project new deliverable dates if recovery is not possible, and project final cost based on work efficiency to date.

Plan Integrity

A plan has integrity when it represents reality. A project deviates from its schedule either because the plan lacks integrity or because unforeseen circumstances (i.e. changes in resource or material availability, incorrect work effort estimates, etc.) are interfering with the planned activities. The purpose of building a plan with integrity is to model reality as closely as possible so that when unforeseen circumstances arise they may be quickly compensated for in the plan to allow rapid recovery of the schedule. There are two aspects to plan integrity: Technical integrity and Structural integrity.

Technical Integrity

Technical integrity is achieved by having subject matter experts (SME's), who are familiar with the work to be done, identify the tasks and participate in plan construction. Project participants may also contribute. For a small project the project manager or team lead may be the only SME. On a large project there may be multiple SME's responsible for various specialty areas. Technical integrity is a function of the experience level of the SME's and how faithfully their knowledge and experience is reflected in the plan.

Structural Integrity

Structural integrity is achieved by having the SME's, the PM, and participants define the interrelationships of the work activities...

To One Another:
- How long will the activity take.
- Who will perform the activity.
- How much work effort will each individual do on the activity.
- Predecessor activities.
- Successor activities

To the Project Environment:
- Holidays.
- Vacation schedules of each resource.
- Length of the work day.
- Overhead for administrative and other duties.

To the Outside World:
- Dependencies on external events and decisions.
- Dependencies on other plans' deliverables.
- Deliverables to other plans, individuals, or organizations.
- Compliance with management objectives.

This Paper Describes:

- The components of a project plan required to produce technical and structural plan integrity.

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- What tracking data should be collected for optimum control.
- How Earned Value metrics are derived from the data collected.
- How Earned Value reports are used to identify and control deviation from plan.

Defining the Plan to a Project Management Tool

Most PM tools provide a wide variety of customizable views of data for planning, tracking, and reporting and one can easily approximate the view shown in Exhibit 1. The data in Exhibit 1 represents the generic project described above "... initiated by one or more external prerequisite events and performing a series of tasks which produce deliverables to the outside world." Imagine it scaled to your own real world project containing multiple prerequisite external dependencies, performing 100's of tasks with 100's of resources, and providing multiple deliverables to the outside world.

Task Description	Days Duration	Resource Initials	Person Days
External Dependency		PM	
Task 1	5	EPM	5.0
Task 2	3	LML	2.0
		RGR	3.0
Task 3	4	EPM	2.0
		RGR	3.0
		LML	1.0
External Deliverable		PM	
Totals			16.0

Exhibit 1. Task Definition

In this plan a single external dependency is prerequisite to three tasks each of which has one or more resources assigned, and it produces a single external deliverable. Notice that each task is defined in terms of its duration, who will work on it, and how much work each resource will do over that duration. RGR, for example, will work 3 person days (PD's) on Task 3 over a 4 day period. This is an average of 3/4 of a PD of work per day. Instead of a person-days column the view could show Availability and RGR available to work on Task 3 3/4ths or 75% of his time.

Task dates should not be specified in the project plan definition. They will be calculated by the PM tool after task interdependencies are defined and the dates of the initiating external dependencies are known (or assumed). Exhibit 2 is an example of a PM tool view for defining the dependency relationships between tasks and external dependencies and deliverables. Most tools provide drag and drop dependency linkage capability.

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External Dependency     v
Task 1                  ^=====v
Task 2                        ^===v
Task 3                            ^=====v
External Deliverable                    v
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Exhibit 2. Predecessor/Successor Definition

Each task will have one or more predecessors and one or more successors defined so that the plan may be scheduled by the project management tool to produce a task and deliverable schedule. Exhibit 3 shows a view of the plan with task and deliverable dates and costs generated by the PM tool.

Task Description	Dur	Resc Initial	PD's	Week 1	Week 2	Week 3
External Dependency				v		
Task 1	5	EPM	5.0	=====		
Task 2	3	LML	2.0			
		RGR	3.0			
Task 3	4	EPM	2.0		===	
		RGR	3.0			
		LML	1.0			====
External Deliverable						v
Total			16.0			
Resource Loading						
EPM			7.00	4.00	1.50	1.50
LML			6.00		3.75	2.25
RGR			3.00		2.25	0.75
Totals			16.0	4.00	5.50	1.00

Exhibit 3. Scheduled Project Plan

In this view task start and end dates are represented by the Gantt bar to the right of each task. For example, Task 1 begins on the second work day of Week 1 and ends on the 1st work day of Week 2. The work effort (or cost) is shown by task (i.e. 6 PD's

for the 3 resources on Task 3), is totaled for each resource over the duration of the project (i.e. RGR works 3 PD's), for each time period (i.e. Week 2 costs 5.5 PD's), and for the total project (16 PD's).

Guidelines for Plan Construction

Consider the following guidelines to ensure technical and structural plan integrity:

1. For a project of any complexity use a computer based project management tool.
2. Define Tasks Using Duration and individual resource Work Effort (or Availability) to specify work and non-work time.

   If you ask a someone how they will perform a particular task you will get two answers. For example, it will take 3 PD's of work effort to install a software module but will take 5 days of elapsed time because of anticipated interruptions and dependencies on information from the vendor and other individuals. The worker knows the characteristics of that task in their environment. If you cannot obtain estimates from the individual workers or knowledgeable SME you may then apply an overhead factor to the 3 PD's to calculate duration. In Exhibit 1 each task has a duration and work efforts for the individual resources performing the work.
3. Define dependency relationships and let the project management tool calculate task and deliverable dates .

   When all tasks are linked in dependency relationships, so that each task has at least one predecessor and one successor, the PM tool will calculate the effect of a change anywhere in the plan at the push of a button. Thus plans may be tuned to meet client or organizational needs, or re-scheduled during implementation to deal with unforeseen circumstances. If dependency relationships are not defined as in Exhibit 2 and instead fixed dates are assigned to each task, one loses one of the most important facilities of the PM tool, the ability to quickly reschedule the plan. A single change anywhere in the plan can ripple through the plan affecting the dates of hundreds of tasks. Without dependency relationships one must manually adjust every affected task's dates. Manual scheduling is extremely tedious and error prone, is considered a high risk practice, and is strongly discouraged.
6. Define organization holidays and resource vacation schedules.
7. Your Baselined Plan is Your Contract/Commitment.

   The plan is complete when all external dependency to deliverable linkages have been resolved and management agrees to deliver the funding and resources on the plan dates. Baseline the plan. Baselining stores task and deliverable schedule and work effort information in the plan as reference for later comparison with progress information. The baseline plan is your contract/commitment with your management, the organizations you have dependencies on, and the organizations that receive your deliverables. Deviations from the baselined work and schedule estimates during execution represent a violation of the original contract which must be corrected. If recovery is not possible then the contract with management and the other affected organizations must be re-negotiated and the plan re-baselined.
8. Plan in Person-Days (PD's) for salaried project participants and Person-Hours (PH's) for hourly workers.
9. Tasks should be predominantly no more than 5 days (one work week) duration.

   When asking project participants what work they have done at the end of each week the only thing one can be sure of is that a task has either not started (Week 1 in Exhibits 4 and 5), started (Week 2 in Exhibit 4 and Week 2, 3, and 4 in Exhibit 5), or completed (Week 3 in Exhibit 4 and Week 5 in Exhibit 5). Between started and completed (Weeks 3 and 4 in Exhibit 5) we rely on the judgment of the worker to tell how much work has been done and how much remains.

Description	Dur	Week 1	Week 2	Week 3	Week 4	Week 5
Task 1	15		==	===		

Exhibit 4. Short Duration Task

Knowing it is human nature to put a positive spin on one's progress, only when Task 2 doesn't complete at the end of Week 5 can we be sure we need to take remedial action, but by that time the task could be up to 15 days behind. By reducing the task duration to 5 days it can be no

more than 5 days behind before it is detected as late.

Descr-iption	Dur	Week 1	Week 2	Week 3	Week 4	Week 5
Task 2	15		==	=====	=====	===

Exhibit 5. Long Duration Task

It is also best to use a weekly reporting period. For example, in Exhibit 4 with weekly reporting if Task 1 is not started the end of Week 2 it can be no more than 2 days behind when we know action must be taken. If it is not completed the end of Week 3 it can be no more than 5 days behind when we know action must be taken. However, if the reporting period is every 2 weeks instead of every week starting with the end of Week 1 we would not know that Task 1 had not started during Week 2 until the end of Week 3, thus opening the possibility the task could be as much as 7 days behind before we realize we must take remedial action.

11. Critical Path and Float.

PM's are taught to focus on the critical path to keep a plan on schedule. However, in a large complex plan one cannot rely on the critical path highlighted by the PM tool, and tasks that are not considered critical will appear to be on it. In Exhibit 6 tasks 1 and 2 are predecessors to Task 3 and Tasks 1 and 3 are on the critical path. The dashes at the end of Task 2 represent 2 days of float. Task 2 could start 2 days later and still not delay the start of Task 3. A delay in Task 2 of more than 2 days will push Task 3 back and make Tasks 2 and 3 the new critical path. This illustrates the sensitivity of the critical path to relatively minor fluctuations in the plan and the fact that one must tune the entire plan, not just the critical path. As you trim fat from the plan other critical paths will appear and you will have more resource to apply to the elusive future critical paths as they appear during execution.

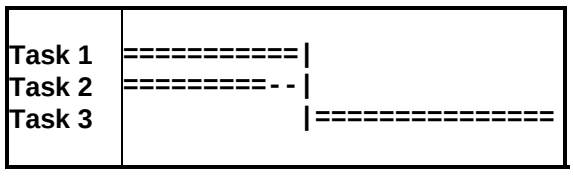

Exhibit 6. Critical Path

A popular technique for delaying costs is to schedule all non critical path tasks at their late start dates. This is places the schedule at high risk by putting every task in the plan, in effect, on the critical path. One missed date and all successors to the missed task will be pushed back in time.

PM's are tempted to manage non critical path tasks less carefully than critical path tasks. After all if one slips, as long as there is enough float, it wont effect the schedule. Keep in mind that the PM tool has scheduled your resources as efficiently as possible. When a task ends its resources are released to be used by other tasks. If you allow a task to slip beyond its early finish date the resources will not be available and other tasks will be delayed.

Conclusion: Treat every path as if it were critical, and manage non critical path tasks as if they were also on the critical path.

12. Use Full Time Professional Project Administrators for Planning, Tracking, and Reporting Support.

The role of Project Administrator (PA) is to relieve project managers and their teams of the need to become project management tool experts in order to plan and control their projects, and to provide an information hub for both project managers and executives. Construction, engineering, and defense industries (companies that do projects for a living) employ full time professional PA's to build and maintain their project plans and provide status reports. PA's are experienced project professionals, often former project managers.

Benefits of using PA's include:

a. Project managers and team members are freed from the need to become project management tool experts and can concentrate full time on planning and controlling their projects.
b. The PA is more expert with the tool because he/she uses it full time.
c. Planning is done more quickly because an experienced PA can start immediately, whereas a project manager or team member may need to be trained in the use of the tool and may take months to become proficient.
d. An experienced full time PA will mentor the inexperienced project team in the

construction of proper project plans and ensure plan integrity.

e. The PA ensures that project reporting is consistent in format and terminology and adheres to organization standards.
f. The PA is single a focal point for management to access project information.
g. Fewer PM tool licenses and less tool training is required because a single PA can handle multiple plans.

Tracking and Reporting

It is now the end of Week 1 and Exhibit 7 shows the results of tracking against the baseline plan. The data is divided into four sections:

Planning					Tracking				Reporting							
1 Data From Baseline Plan					2 - Data From Project Participants				3 Earned Value			4 Status				
Task Description	Baseline Duration	Resource Init	Baseline PD's	Baseline End Date	Proj or Act End Date	PD's Comp	PD's Remaining	Status or C	Budg Cost of Work Sched	Budg Cost of Work Perf	Actual Cost of Work Perf	% Cpl	Proj PD Cost at Comp	PD's Behind	Open Task PD Variance	Open Task End Date Variance
External Dep		PM		1/1	1/1			C								
Task 1	5	EPM	5.0	2/1	2/3	3.0	3.0	S	4.0	2.5	3.0	50	6.0	-1.5	-1.0	-2
Task 2	3	LML	2.0	2/4			2.0									
		RGR	3.0				3.0									
Task 3	4	EPM	2.0	3/3			2.0									
		RGR	3.0				3.0									
		LML	1.0				1.0									
External Deliv'ble		PM		3/3			0									
Totals			16.0			3.0	14.0		4.0	2.5	3.0	16	19.2	-1.5	-1.0	-2

Exhibit 7. Status as of the End of Week 1

Section 1 - The Original Baselined Plan

This is the plan shown in Exhibit 3 but instead of the Gantt bars the task end date fields are shown. To make this illustration generic, instead of using real dates the date format is Week/Day. Task 1, for example, ends on 2/1 (Week 2, Day 1) as can be seen from the Gantt bar in Exhibit 3.

Section 2 - Participant Input

This is the data obtained from participants at the end of each week as they execute their tasks. Only three fields are required for each task, Projected or Actual End Date, PD's Completed, and PD's Remaining. Only Status is required for each milestone. External dependencies and deliverables are milestones. Note that the External Dependency's Status = C for complete on its original plan date of 1/1, and Task 1 Status = S for started because work was posted against the task.

One can see from Exhibit 3 that EPM should have completed 4 PD's of work on Task 1 by the end of Week 1 but only 3 PD's are posted on Exhibit 7 in the PD's Comp field, and he estimates 3 PD's or work remain. This makes the task 6 PD's instead of the original estimate of 5 PD's. EPM also reported that Task 1 will complete on 2/3 instead of the originally planned date of 2/1 making the task 7 days duration instead of the original estimate of 5. Section 3 illustrates the three Earned Value input fields from which all Earned Value metrics are derived. The Budgeted Cost of Work Scheduled (BCWS) for Task 1 is 4 PD's, the original estimate of work to be completed the end of Week 1 as seen in Exhibit 3.

The Actual Cost of Work Performed (ACWP) is 3 PD's as reported by EPM in the PD's Comp field on Exhibit 7.

The Earned Value of a task is its Budgeted Cost of Work Performed (BCWP). It represents the credit earned against the original budget based upon the % Complete of the task. One may simply ask the participant to estimate this value but estimates tend to by overly optimistic. Or one may apply one of the many rules established to avoid subjectivity. For example, the task may be assumed to be 50% complete when started and 100% when completed, no gradations in between.

In this example we have asked EPM to report both the work done (3 PD's) and the work remaining (3 PD's) from which we can calculate the total task is now estimated to be 6 PD's the task is 50% complete. BCWP is 50% of the originally budgeted 5 PD's or 2.5 PD's.

Status - Section 4

In section 3 we calculated the % Complete of Task 1 is 50%. Since the total BCWP for the project is 2.5 PD's of earned progress against its original total baseline budget of 16 PD's the project % Complete is the Total BCWP/Total Baseline PD's = 2.5/16 = 16%.

The Projected Cost at Completion for Task 1 is 6.0 PD's as estimated by EPM. The Projected Cost at Completion for the project is the ratio of real work it has taken (ACWP) to produce the current total Earned Value (BCWP) times the origninal project budget. ACWP/BCWP x Original Budget = 3.0 PD's/2.5 PD's x 16.0 PD's = 19.2 PD's. This is 3.2 PD's over budget.

The following three status metrics are designed to focus attention on currently active tasks that have deviated from plan, may still be corrected, and will affect future tasks and deliverable dates. The values do not include tasks that have already completed since at this time they can no longer be corrected:

PD's Behind is the amount of work that should have been done by report time that was not. 4.0 PD's should have been done (BCWS). The Earned Value of work done (BCWP) is 2.5 PD's. PD's Behind is BCWP - BCWS = -1.5 PD's and represents the amount of work that should have been done that was not.

Open Task PD Variance is the difference between the Baseline PD estimate and the participant's current Projected PD Cost at Completion. Open Task PD Variance for Task 1 is 5.0 PD's - 6.0 PD's or -1.0 PD.

Open Task End Date Variance is the difference between the Baseline End Date and the current Projected End Date. For Task 1 it is 2/1 - 2/3 = -2 Days. For the project it is the sum of End Date Variances for all open tasks.

Using the Status Report

The Totals line in Exhibit 7 represents the status of this project. The project is 16% complete, is currently projected to cost 19.2 PD's, 3.2 PD's over budget at completion, 1.5 PD's of work should have

1 Data From Baseline Plans			2 Earned Value			3 Plan Status						
Project Name	Owner	Baseline PD's	Budg Cost of Work Sched	Budg Cost of Work Perf	Actual Cost of Work Perf	PD's Remaining	Proj PD Cost at Comp	Proj PD Variance at Comp	% Cpl	PD's Behind	Open Task PD's Variance	Open Task End Date Variance
Hardware 3.1	Bob Hall	14087	7641	7629	7699	6500	14197	-110	54%	-12	-22	-3
EOSE	Marco Mazzotti	12995	9863	9846	9875	2256	13131	-36	91%	-17	-7	-13
Core Config	Gary Kroc	875	116	107	109	786	895	-20	12%	-9	-3	-4
Hardware 2	Beth Gamble	3784	2717	2696	2706	1092	3798	-14	71%	-21	-2	-3
Entitled Software	Simone Crane	3209	2209	2206	2212	1006	3218	-9	69%	-3	-1	0
Transaction Hub	Gail Smith	234	23	23	23	212	235	-1	10%	0	2	-1
Packaged Swr	Larry Reymond	10978	582	547	547	10428	10975	3	5%	-45	-4	-6
Info Source	Henry Jones	2293	2084	2091	2087	207	2294	4	91%	-3	1	-7
Totals		47560	25254	25144	25240	22485	47743	-183	53%	-116	-36	-39

Exhibit 8. Portfolio Status Summary Report

been completed that were not, currently open tasks are projected to require 1 more PD than originally estimated, and there are 2 days of aggregate schedule End Date lateness which, if not corrected, will impact the deliverable date. This illustration shows only one active late task. If there had been 10 active late tasks the totals would reflect all 10 and one could scan the status columns or filter the view looking for the most significant lateness to take remedial action. A view combining Exhibit 3's Gantt chart and Exhibit 7's status information allows one to see what tasks are affected by the lateness of the currently open tasks. Note the plan in this example has not been re-scheduled to reflect the delay in Task 1's completion.

Re-scheduling the plan would show the impact of the uncorrected lateness on future tasks and deliverables. Remedial action must be taken to adjust Tasks 1, 2, and 3 so that Task 3 still finishes on its original planned date. If this cannot be accomplished the External Deliverable will slip, the plan will need to be re-scheduled, and a new contract and baseline established for the revised deliverable date.

Multi-Project Reporting

In a multiproject environment a summary report containing the Totals line from every plan provides management with an overview of their project portfolio and highlights where to focus attention. Projects with the highest negative status numbers are of greatest concern. Exhibit 8 is an example of a portfolio status report. The field definitions for this report are the same as for Exhibit 7.

The 8 plans in this portfolio have been sorted in Projected PD Variance at Completion sequence to highlight which plans are the furthest from their target cost and should receive the most attention. Hardware 3.1 is in the lead with 110 PD's of projected overrun, and Info Source is in the best shape projecting 4 PD's under budget. The project executive will probably be meeting with Bob Hall. With 53% of the 47,560 PD portfolio completed these projections are probably pretty reliable. The report could be sorted in any sequence desired.

This report is well suited to identifying what needs to be fixed today to stay on schedule. For example, Packaged Swr, with only 5% of its work completed accounts for 45 of the total 110 PD's Behind this week, Hardware 3.1 has 22 of the total 36 Open Task PD Variance, and EOSE has 13 days of the total 39 day Open Task End Date Variance.

Summary

A realistic detailed project plan is essential to the success of any complex project. Easy in principle to construct, as shown in Exhibits 1, 2, and 3, the more complex the project, the more work will be required to accurately represent the content and sequence of the work, but the payback is significant. The budget will be more accurate, resources can be coordinated, deliverable dates can be projected, and progress monitored and controlled using just a few simple Earned Value metrics. Project managers and executives will need detailed project plans in a multi-project environment so they can see what plans require attention (i.e. Exhibit 8) and what tasks within a plan (i.e. Exhibit 7) require remedial action.