

DEFINING %COMPLETE IN MICROSOFT PROJECT

PREPARED BY



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Managing Projects with Microsoft Office Project 2007

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1 INTRODUCTION

The key to understanding percent complete is to recognize the value is a fraction. To obtain a fraction, divide two numbers. This implies the user knows which two numbers to divide: Bricks laid divided by total bricks required, wages paid divided by total budget, work hours spent divided by total work hours estimated. Without knowing which two numbers to divide, a percent complete is just a number for misinterpretation by others. The real questions here are: "If I am on schedule, how many bricks should I have laid? How many dollars in wages should I have paid? How many work hours should have been expended? How much cost should I have incurred?"

2 BACKGROUND

Microsoft Project contains three measures of "%Complete." Many users of the software want to know: If they are on schedule, what should be the values calculated by each of the measures of percent complete. The three measures are: Percent Complete (%Complete), Percent Work Complete (%Work Complete), and Physical % Complete. Additional measures are available if created by the user.

3 PERCENT COMPLETE CALCULATION TYPES

3.1 Percent Complete

The default method of measuring "%Complete" by Microsoft Project is based on activity duration, a 10 day activity is 40% Complete at the close of business on the 4th work day from the start date of the activity. Microsoft Project will indicate this task is "late" if the value for %Complete is less than the expected value as of the status date. This information is viewable in either the status indicator or status columns.

The formula to roll up %Complete for summary level tasks, and eventually the entire project is given by:

$$\frac{\sum_{i=1}^{i=task} \%Complete_i * Duration_i}{\sum_{i=1}^{i=task} Duration_i}$$

Equation 1 Duration Based Percent Complete

Using Figure 1 below, Microsoft Project will calculate the percent complete as follows:

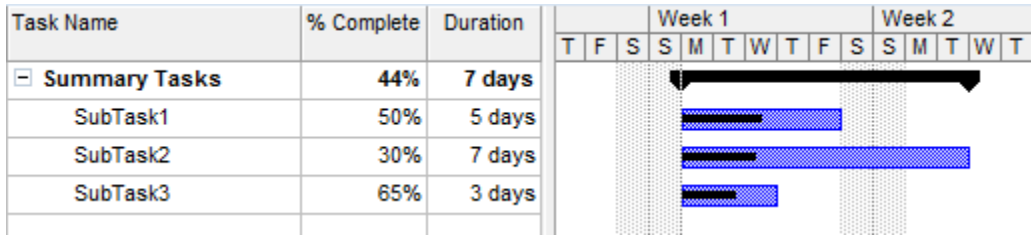


Figure 1 Percent Complete Screen Shot

$$\%Complete = [(50\% * (5 \text{ days}) + 30\% * (7 \text{ days}) + 65\% * (3 \text{ days})) / (5 \text{ days} + 7 \text{ days} + 3 \text{ days})]$$

$$\%Complete = 43.6667\%$$

Microsoft Project will round to the nearest whole integer, 44%.

3.2 Percent Work Complete

Percent complete based on the number of work hours completed is another measure calculated by Microsoft Project. For this purpose, two resources will be loaded to the tasks with work as shown.

Resource Name	Std. Rate	Type
Worker 1	\$86.00/hr	Work
Worker 2	\$19.00/hr	Work

Figure 2 Resource Sheet

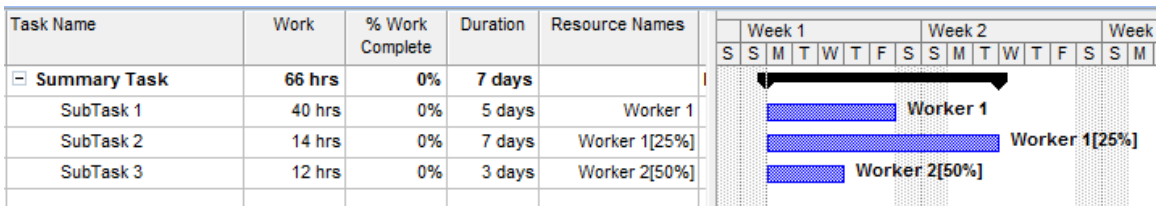


Figure 3 Resource Loaded Schedule Showing Total Work

The man-hour profile for work-hours is loaded with the majority of the work in the first three days:

Task Name	Work	Details	Week 1							Week 2			
			S	M	T	W	T	F	S	S	M	T	W
[-] Summary Task	66 hrs	Work		14h	14h	14h	10h	10h				2h	2h
[+] SubTask 1	40 hrs	Work		8h	8h	8h	8h	8h					
[+] SubTask 2	14 hrs	Work		2h	2h	2h	2h	2h				2h	2h
[+] SubTask 3	12 hrs	Work		4h	4h	4h							

Figure 4 Work Profile (Task Usage View)

Percent work complete is calculated in accordance with an effort based weighting:

$$\%WorkComplete = \frac{\sum_{i=1}^{i=tasks} \%WorkComplete_i * Work_i}{\sum_{i=1}^{i=tasks} Work_i}$$

Equation 2 Percent Work Complete

Using the same percentages as the original example, the calculation becomes:

$$\%Work\ Complete = [50\%*(40) + 30\%*(14) + 65\%*(12)]/[40+14+12]$$

$$\%Work\ Complete = 48.48\%$$

Microsoft Project confirms the calculation:

Task Name	Work	% Work Complete	Duration	Resource Names	Week 1							Week 2							Week						
					S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M				
<input checked="" type="checkbox"/> Summary Task	66 hrs	48%	7 days																						
<input type="checkbox"/> SubTask 1	40 hrs	50%	5 days	Worker 1																					
<input type="checkbox"/> SubTask 2	14 hrs	30%	7 days	Worker 1[25%]																					
<input type="checkbox"/> SubTask 3	12 hrs	65%	3 days	Worker 2[50%]																					

Figure 5 Percent Work Complete Screen Shot

3.3 Physical Percent Complete

When the desired unit of measure is Physical Percent Complete, a baseline is required and the calculation is based on the dollar costs involved. In this case, the cost of the project is spread as shown below:

Task Name	Cost	Work	Details	Week 1							Week 2						
				M	T	W	T	F	S	S	M	T					
<input checked="" type="checkbox"/> Summary Task	\$4,872.00	66 hrs	Work	14h	14h	14h	10h	10h									
			Cost	\$936.00	\$936.00	\$936.00	\$860.00	\$860.00						\$172.00	\$172.00		
<input type="checkbox"/> SubTask 1	\$3,440.00	40 hrs	Work	8h	8h	8h	8h	8h									
			Cost	\$688.00	\$688.00	\$688.00	\$688.00	\$688.00									
<input type="checkbox"/> SubTask 2	\$1,204.00	14 hrs	Work	2h	2h	2h	2h	2h						2h	2h		
			Cost	\$172.00	\$172.00	\$172.00	\$172.00	\$172.00						\$172.00	\$172.00		
<input type="checkbox"/> SubTask 3	\$228.00	12 hrs	Work	4h	4h	4h											
			Cost	\$76.00	\$76.00	\$76.00											

Figure 6 Costed Resource Loading

For the moment, the Project Status Date will be set far into the future, past the last day of the project. In this case, although any measure of the three measures of percent complete should indicate a behind schedule condition, the Physical % Complete appears in the figure below:

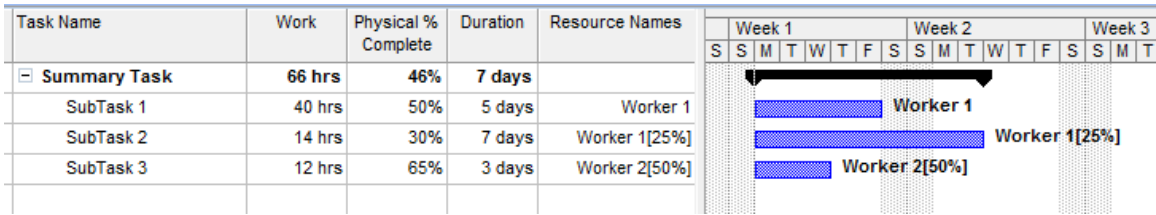


Figure 7 Physical Percent Complete Screen Shot

The equation used by Microsoft Project depends on the dollar value of the work budgeted and is shown below:

$$Physical\% Complete = \frac{\sum_{i=1}^{i=tasks} Physical\% Complete_i * BAC_i}{\sum_{i=1}^{i=tasks} BAC_i}$$

Equation 3 Physical Percent Complete

Note: BAC is Budget At Complete, Total Cost, or Baseline Cost.

The details of the calculation are:

$$Physical\% Complete = [50%(\$3,440) + 30%(\$1204) + 65%(228)] / [\$4872]$$

$$Physical\% Complete = 46\%$$

Further analysis regarding calculation of Physical % Complete is in a later section of this paper. Specifically, what happens when the status date is before or during the period of performance of tasks?

4 ANALYSIS

The previous section describes three methods of determining percent complete. In each case, the value claimed for percent complete was numerically identical for the three discrete tasks (50%, 30% and 65%, respectively). The weighted value of the calculation produced a different result in each case at the summary level. In the example, the values are close. However, consider what might happen if there was a large discrepancy in the amount of work assigned to the tasks, or, if the costs of the resources were vastly different from each other.

Further, the measures of percent complete (Duration, Work, and Physical) all represent different things. Although the possibility does exist that the measures could theoretically be equal under certain circumstances, the general case is the measures will not be numerically equal. If a project marches along "on schedule" the table below will show the cumulative % Complete for each calculation type:

Table 1 Expected Values of Percent Complete

Method vs. Day	%Complete	%Work Complete	Physical % Complete
1	20	21	19
2	40	42	39
3	60	64	58
4	73	79	75
5	87	94	93
6	93	97	96
7	100	100	100

Graphically the results are different for each method of percent complete as a function of time:

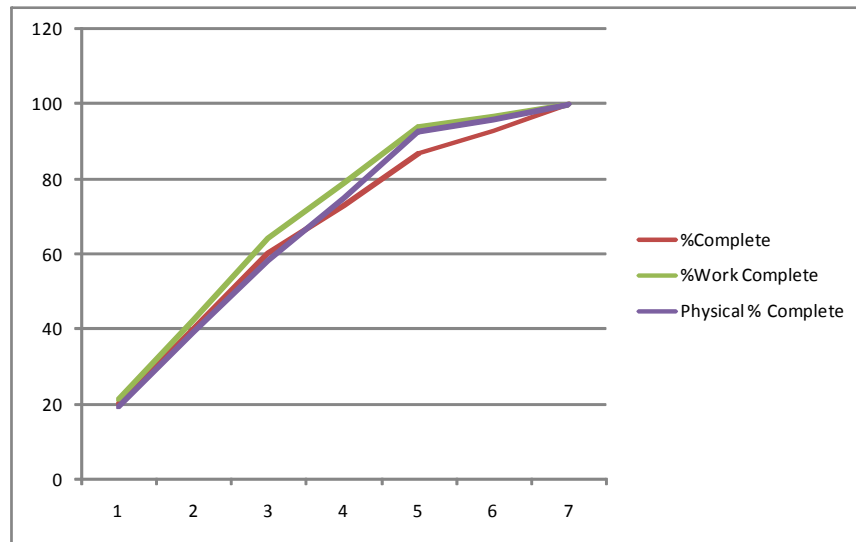


Figure 8 Graphical Illustrations of Three Methods of Percent Complete

4.1 Duration Analysis (Detail Tasks)

By definition, the duration percent complete of a task grows only with the passage of time and is always on schedule. Since it is duration based measurement, unless the task has not started and needs to be delayed, the user should always claim the tasks to be "as scheduled" when updating the duration based percent complete. Where the calculation will vary is when the user makes updates to the remaining work and remaining duration fields. This author has no understanding of the concept a user can claim any duration based %complete and then provide remaining duration estimates that are inconsistent with the percent complete provided. In the case of

duration based percent complete, it is best to adjust remaining duration (or remaining work) and let the software calculate the percent complete. If the user provides remaining work or duration greater than calculated by the program, the %Complete value will regress. If the user revises the remaining duration/work to be less than calculated by the program, the %Complete increases. Depending on the reporting rules in place on the program, it may be a violation of reporting rules to allow the percent complete to decrease from a prior reporting period.

If an estimator believes it will take three days to paint 24 feet of fence, the planned profile will be 33% per day. If at the end of the first day the painter claims four additional days are needed, then the job is $1/5 = 20\%$ duration complete (1 day of actual duration, 4 days of remaining duration).

What the user really wants to know is how the 20% complete calculation compares to the 33% complete that is expected (the baseline). Indeed, what duration percent complete is expected for the purpose of this comparison as of the status date (end of day 1)? The answer is 33% and the painter met $20/33=61\%$ of expectation (39% behind schedule).

What can be done in a case such as this? If the task is originally assigned as fixed units with one resource, then management needs to decide how to recover from the given situation. There appears to be several choices:

- Clearly the painter has re-estimated the job, perhaps because of increased intelligence gained during the performance of Day1. The painter provides a revised estimate to complete so the cost of the job increases (from 24 hours to 40 hours). Management must decide if the additional cost will be absorbed or passed on to the customer, and, if the additional duration is acceptable to all the stakeholders.
- Substitute a resource and assign the task to someone who can complete the job within the remaining baseline duration (2 remaining days). This may change costs.
- Change technology, perhaps the painter can use spray equipment as opposed to a brush and complete on the baseline finish day (Day 3). This may also impact cost.
- Man-load the task with additional workers (perhaps at increased cost) to save the baseline duration, or at least compress duration. It is a matter for management to reconcile estimating practices that 24 man-hours were estimated for the job when the performing organization provided a higher estimate once the task was underway and more information was known. Of course this scenario that sooner or later

the maximum amount of productive resources will have already been added to the job and adding more resources will decrease productivity.

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